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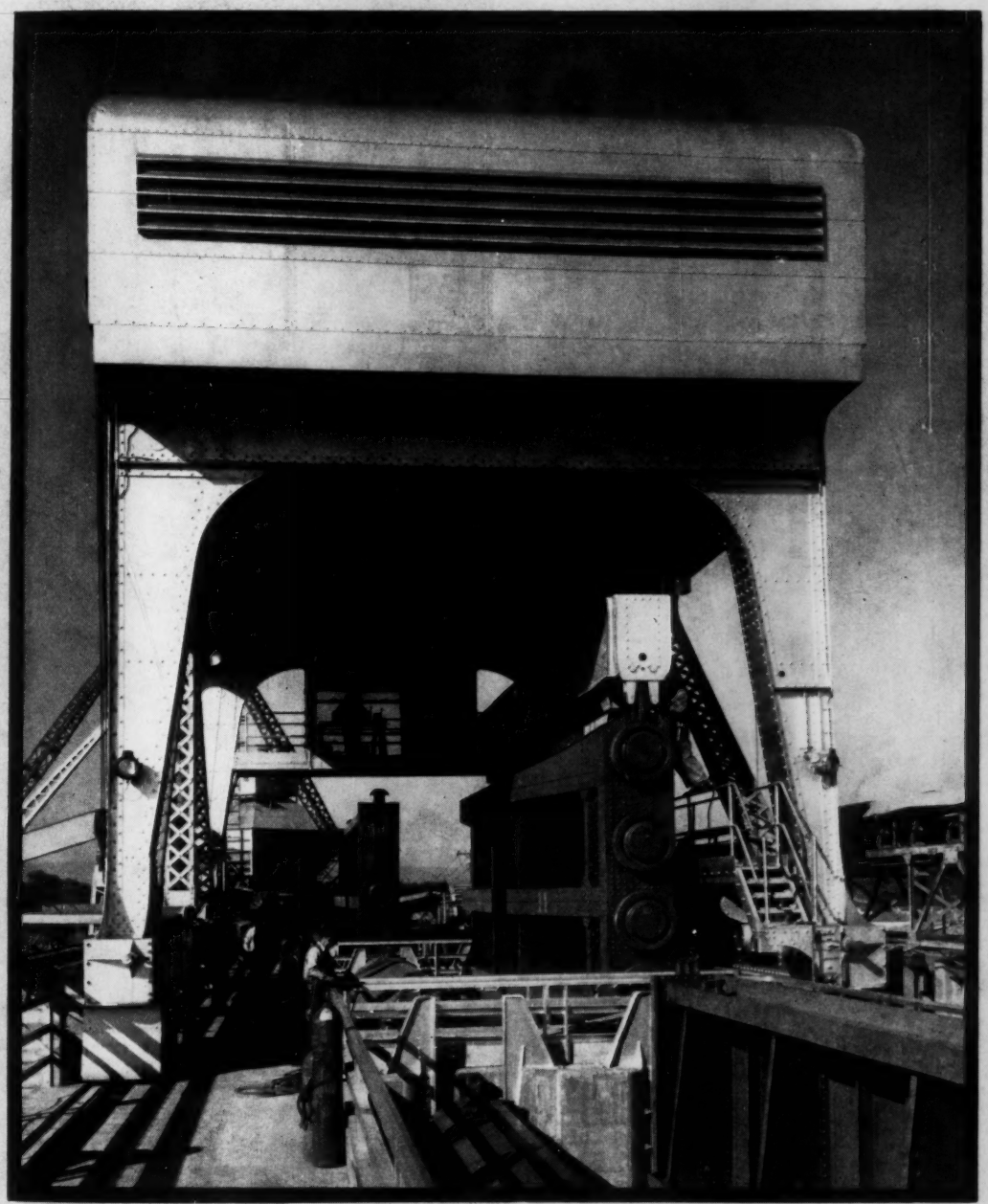

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VOLUME 15 NOVEMBER 1945 NUMBER 11

Protecting Upstream Slope of Kingsley Dam

By HENRY H. JEWELL, M. AM. SOC. C.E.
ASSISTANT CHIEF ENGINEER, FEDERAL WORKS AGENCY, WASHINGTON, D.C.

SEVERE erosion by wave action was a difficulty to be overcome by engineers at Kingsley Dam. Pre-cast concrete-block riprap failed to protect the earth fill from this destructive force. The latest surfacing, a filter layer topped with rock riprap, promises to "stay put" when wind and waves go on a rampage.

KINGSLEY Dam, on the North Platte River about 7 miles north of Ogallala, Nebr., is the second largest earth-fill dam in the world. Constructed from 1938 to 1941 by the Central Nebraska Public-Power and Irrigation District as part of a large PWA water power and irrigation project, it is exceeded in size by but one other earth dam, Fort Peck Dam on the Missouri River. Thirty million cubic yards of earthwork were required, of which 25,330,000 cu yd were hydraulic fill. The crest of the dam is approximately 13,000 ft in length and the maximum height is about 170 ft. The spillway is of the "morning-glory" shaft type having a capacity of 54,000 cu ft per sec. The dam creates the principal storage reservoir for two Nebraska hydroelectric power and irrigation projects in which the government has an investment of $56,000,000. A cross section of the dam appears in Fig. 1.

The area of the upstream slope to be protected from wave action is 360,000 sq yd. Since the full reservoir contains 2,000,000 acre-ft of water and extends for a distance of 23 miles upstream in a northwesterly direction, from which come winds of maximum velocity, the protection of this upstream slope presented one of the most interesting and important features of the project. The magnitude of its importance perhaps was not fully realized when the original protection was designed. Because of the scarcity of suitable riprap rock and large gravel within a reasonable transportation distance from the dam, it was believed that the cost of rock riprap would be prohibitive. The nearest source of suitable quarry rock is in southeastern Wyoming, requiring a railroad haul of about 200 miles at a cost of $1.70 per ton. After considerable research and study of other types of riprap, a concrete-block riprap was designed. When bids received on both rock and concrete block showed costs in favor of the latter by more than a million dollars, it was decided to construct the entire protection for the upstream slope of concrete blocks.

Design of the concrete-block riprap is shown in Fig. 2. The blocks were precast in sections 4 ft 6 in. long. Depth of blocks varied from 12 in. at El. 3180 to 18 in. at 3270 and above. Widths were 6 to 6½ in., except for the lug projections which separated the rows of blocks by a 3-in. space, except that an overhang cast along the top edge of each block reduced the actual opening along each row to a width of 1 in. Wrought-iron locking bars ⅜ in. in diameter on 2-ft 3-in. centers extended through the cells in the blocks from an anchorage in the toe wall to one in the wave wall. The largest blocks weighed 374 lb.

HYDRAULIC FILL ON UPSTREAM FACE

The contract specifications for the hydraulic fill required that the upstream surface of the dam should consist of "a 24-in. bedding of selected shell material, . . . obtained by selecting the coarser material while being deposited by the dredge pipe." During construction of the dam, the material secured from the borrow pits did not contain as much coarse material as had been expected from the tests made prior to construction. The final result was that the upstream surface of the dam con-

KINGSLEY DAM AFTER COMPLETION OF CONCRETE BLOCK RIPRAPPING—1942

tained very little coarse material, and the concrete riprap blocks were placed on material consisting of sand and a very small percentage of small gravel. The me-

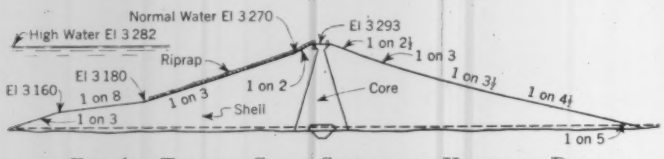


FIG. 1. TYPICAL CROSS SECTION OF KINGSLEY DAM

chanical analysis of the upstream surface material, for an average of 29 samples, is given in Table I.

Before the concrete-block riprap design was adopted, rather extensive tests were made for determining the effects of wave action on the blocks when laid on sand-gravel bedding of various gradations, and with the space between rows of blocks, and the cells in the blocks filled with the same graded material. The tests were performed by two methods. In Method 1, bedding material and concrete blocks were placed in a horizontal box 4 ft 6 in. by 3 ft 2 in. by 3 ft 6 in. (depth), containing a $2^1/_2$-in. pipe along the bottom center, through which water was forced upward by a centrifugal pump. In Method 2 a section of the riprap was laid on the 1-on-3 slope of the dam and water was forced under, through, and over the blocks. Although these experiments could not have been conclusive, they influenced the decision that the shell material was satisfactory as a bedding for the concrete riprap blocks.

As actually constructed, the cells in the blocks and the spaces between the blocks were filled with the same shell bedding material as that on which the blocks were laid. The blocks were placed so that their top surfaces were on a steeper slope than that of the face of the dam. On the 1-on-3 slope, the side of one block projected $3^1/_4$ in. above the edge of the next block above. Consequently the block riprap presented a serrated surface, designed to break up the force of the waves.

DAMAGE BY WAVE FORCES

The contract for the manufacture and placement of the concrete blocks provided for 317,500 sq yd of pre-cast blocks at a cost of $1,011,015, an average of $3.19 per sq yd. The contract work was completed in the fall of 1941.

Storage of reservoir water was commenced in February 1941, and by the latter part of March 1942 the water surface had reached El. 3202, or 22 ft above the bottom of the riprap. High waves caused by winds from a northwesterly direction, during the period March 25–29, 1942, caused minor settlement of blocks over most of the area subjected to wave action, and a maximum of 2 ft of settlement in some areas near the north end. The areas of maximum settlement were immediately repaired by filling the cavities with gravel. High-velocity winds

TABLE I. ANALYSIS OF UPSTREAM SURFACE MATERIAL

SIEVE NO.	% RETAINED	SIEVE NO.	% RETAINED
$1^1/_2$ in.	0.2	10	35.4
1 in.	2.8	14	46.6
$^3/_4$ in.	5.8	20	55.8
$^1/_2$ in.	9.6	30	64.6
$^3/_8$ in.	12.2	40	80.9
3	15.3	50	88.6
4	19.5	80	94.5
6	23.0	100	95.6
8	30.4	200	98.8

next occurred in the early part of May 1942, when the water was at El. 3230, resulting in settlements up to 5 ft in part of the affected area.

After inspection of the damaged riprap, the board of consulting engineers employed by the District reported, in part, "it was found that the gravel backing of the riprap was so fine that it was removed by wave action," and recommended that "graded gravel, so coarse that it will not be washed out by future storms, be placed to fill the voids under blocks which have moved," and that the openings between blocks parallel to the axis of the dam over the entire surface of the riprap be grouted with a 1:3 cement sand grout after removal of sand gravel filling to a depth of 6 in. It was also recommended that all depressions in the damaged areas deeper than 2 ft be filled with rock riprap and grouted.

REPAIRS UNDERTAKEN

The District immediately commenced a major program of repairs by force account, carrying out the recommendations of the board of consulting engineers. In the area grouted, weep holes $^1/_2$ in. deep, on 12 to 24-in. centers, were placed in the grouted joints. The entire surface above water was repaired in this manner.

On December 1, 1942, when the reservoir level was at El. 3226, a severe wind-storm, reported to reach a velocity of 50 miles an hour, caused waves estimated at 8 to 9 ft in height to strike the upstream face of the dam. In the newly grouted area, the waves caused seven openings, the largest being 100 ft long. The following March additional damage was caused by wave action during high winds. The repaired and grouted pre-cast concrete-block riprap, for a distance of about 3,500 lin ft between Els. 3228 and 3240, was seriously damaged.

By this time it was realized that the concrete-block riprap, although supposedly strengthened by grouted

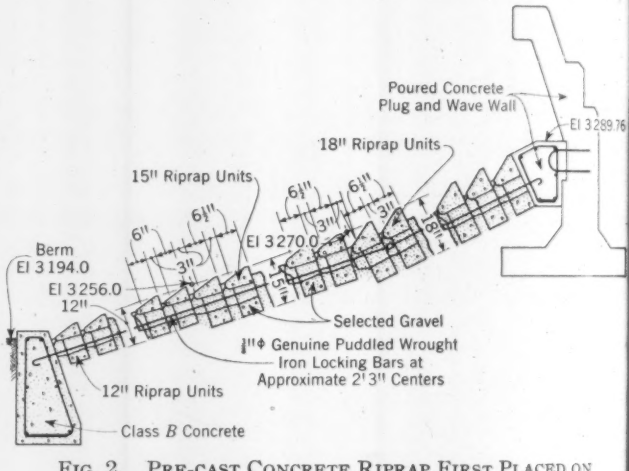


FIG. 2. PRE-CAST CONCRETE RIPRAP FIRST PLACED ON UPSTREAM SLOPE OF DAM

joints, was wholly inadequate for the purpose for which it was designed. The District then commenced repairs using the following method. Where the concrete blocks were undermined, they were broken down and the holes filled with a layer of rock spalls at least 15 in. thick. These spalls generally ran from the $^1/_4$-in. up to about the 10-lb size. Rock riprap 36 in. thick was then dumped on the spalls, using stones weighing from about 10 to 200 lb. At the junction with the sound concrete blocks, the rock riprap was to be sealed and joined to the blocks by cement-sand grout.

A contract was awarded in December 1943, and completed in July 1944, to complete the repairs up to El. 3230, following in general the methods used by the District in its force-account repair work with spalls and rock riprap. This construction has successfully withstood

wave action to date although no wind velocities have occurred equal to the highest of those causing the damage to the concrete-block riprap.

In November 1943, the Administrator of the Federal Works Agency directed the Chief Engineer, FWA, to investigate the failure of the concrete riprap and to make recommendations as to reconstruction and completion of the upstream slope protection. Field investigations and reports were immediately made by engineers of the Chief Engineer's Office, FWA. Consultants were also engaged, who made independent examinations, reports, and recommendations. After completion of these investigations, it was unanimously agreed that the upstream slope from El. 3180 to the crest of the dam at El. 3293, except that part already repaired between Els. 3210 and 3230, should be protected by an adequate filter layer covered with rock riprap (Fig. 3). Although engineering opinion was unanimous that it would not be satisfactory to construct the new filter layer on the existing pre-cast concrete blocks without breaking up the blocks, there was some difference of opinion at that time as to whether or not these blocks should be broken up on the surface of the dam or entirely removed.

PLACING THE FILTER BLANKET OF MIXED GRAVEL AND ROCK SPALLS
Rock Riprap in Place at Right

Specifications were then prepared through collaboration among the District's engineers, consulting engineers, and the Chief Engineer, FWA. These specifications provided that the existing pre-cast concrete blocks, except those submerged below El. 3210, be removed, broken up, and mixed with the new riprap. The filter layer was designed to prevent washing out of the fine gravel and sand of the shell of the dam under wave action and to prevent movement of the filter-layer material through the voids in the rock riprap by wave forces.

A filter layer of gravel 15 in. thick, graded from 1/4 in. to 2 1/2 in., of quality equal to that generally specified for first-class portland cement concrete, or of quarry stone 1/4 in. to 4 in., was specified to be placed on the slope after the concrete blocks were removed. On the filter layer, rock riprap 36 in. thick was to be dumped. In addition to the usual requirements for durability, the specifications provided that the rock riprap "shall be the product of the quarry after excluding all rock smaller than 4 in. in greatest dimension, and including all rock produced above this size up to a maximum size of 6 cu ft (1,000-lb rock) or as large size as it is practicable to unload through standard bottom-dump side-door railroad cars. At least 5% by weight shall exceed 500 lb each. More than 50% by weight shall be individual pieces weighing 100 lb or more. The grading shall be sufficiently coarse so that some hand work is required to unload bottom-dump cars." It was specified that the rock riprap "shall be struck off by power equipment. . . . Rock shall be carefully dumped and placed in a manner to require little or no hand rehandling in order to obtain the required thickness up to El. 3270. The rock shall be dumped and struck off in a manner which will distribute the heaviest pieces throughout the full depth and thus avoid a top surface made up of all small pieces. Above El. 3270, where the slope is about 1.8 to 1, hand work may be required."

During the period of riprap damage and repair, the elevation of water surface of the reservoir varied from approximately 3202 to 3230. District water-power plants and irrigation works had been placed in operation, and therefore, from an operating and financial viewpoint, it was essential that the reservoir storage be maintained at levels sufficiently high to assure ample water supply. Hence it was not feasible to lower the reservoir level to the lower limit of the concrete blocks. In fact, the minimum water surface below which the reservoir cannot be drawn without danger of loss of firm power, is about 25 ft above the lowest riprap. This meant that work on that part of the riprap submerged to a depth of 25 to 50 ft—depending on the reservoir water surface elevation at the time of reconstruction—had to be done subaqueously.

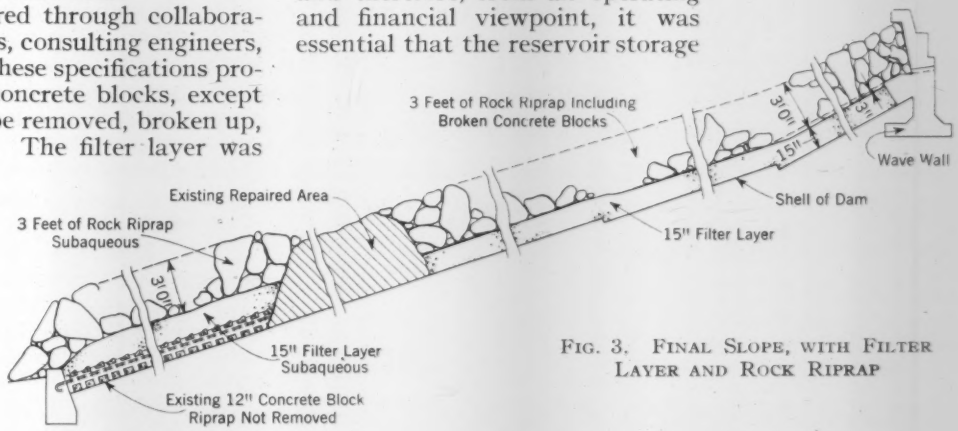


FIG. 3. FINAL SLOPE, WITH FILTER LAYER AND ROCK RIPRAP

For the subaqueous work below El. 3210, a filter layer 15 in. thick and a 36-in. rock riprap of the same specifications as for dry work were specified to be deposited on the submerged concrete-block riprap "by dumping from barges, or from derricks or cranes operating from the dam, or by other methods approved by the Engineer." As of October 1, 1945, this subaqueous work has not been commenced but preliminary trials have indicated that satisfactory results can be secured in this manner. No

TYPICAL DAMAGE TO CONCRETE BLOCK RIPRAP FROM WAVE ACTION

attempt is to be made to remove the concrete blocks in the submerged area.

CONTRACT WORK

Bids for the new filter layer and rock-riprap slope protection were received in September 1944. A contract was awarded immediately thereafter to Tobin Quarries, Inc., which had just completed the rock riprap work between Els. 3210 and 3230. Work under the new contract specifications was commenced on September 28, 1944. This contract included the following estimated quantities and unit prices:

190,000 sq yd, removal, break-up and replacement of existing concrete block riprap	at $0.45
248,500 tons, filter layer	at 2.20
512,600 tons, rock riprap	at 2.45

The contract price was $1,886,070 without railroad freight charges on filter and riprap materials, which

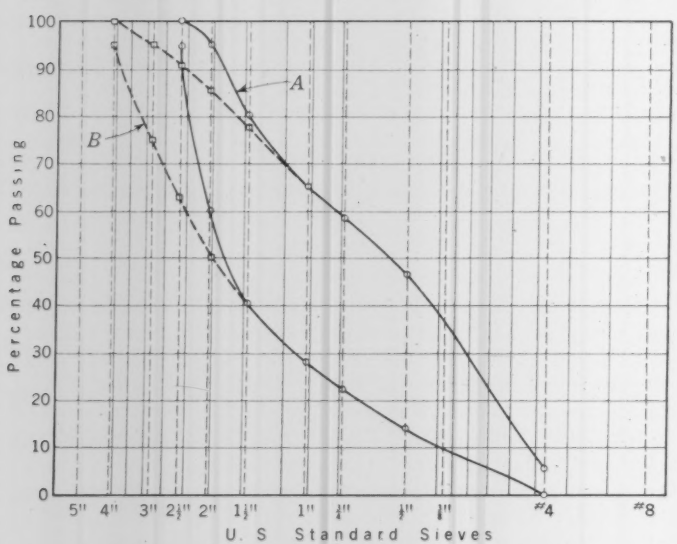


FIG. 4. FILTER-LAYER GRADING CURVES

Curve *A* Represents Gravel or Gravel and Rock from No. 4 to 2½-In.; Curve *B*, that from No. 4 to 4-In.

were to be paid by the District in the estimated amount of $953,870, making the total cost of this contract work $2,839,940.

The contractor is supplying rock and small quarry stone from quarries located near Guernsey, Wyo. These materials are shipped by railroad in bottom-dump cars to a siding at the north end of the dam, where part of them is unloaded by clamshell cranes into trucks and part is dumped from the cars on trestles and is loaded into trucks by power shovel. For most of the work above El. 3230, these materials then have been hauled by truck to the crest of the dam, where they have been dumped into chutes extending down the upstream slope to points of placement by bulldozer and manual labor.

TABLE II. GRADING LIMITS OF FILTER LAYER MATERIAL, IN PERCENTAGE PASSING VARIOUS SCREEN SIZES

	4-In.	3-In.	2½-In.	2-In.	1½-In.	1-In.	¾-In.	½-In.	¼-In.	No. 4
"A"	....	...	95–100	60–95	40–80	28–65	22–58	14–46	...	0–5
"B"	95–100	75–95	63–91	50–85	40–78	28–65	22–58	14–46	...	0–5

"A": Gravel or gravel and rock—No. 4 to 2½-In.
"B": Gravel or gravel and rock—No. 4 to 4-In.

Under the terms of his contract, the contractor agreed to furnish 200,000 tons of filter-layer material delivered by truck, on which there would be no freight charge. This apparently was to be gravel from some nearby source.

The fact that coarse gravel is lacking in the general area in which the Kingsley Dam is located has been well established for many years. That fact, together with the known non-existence of hard quarry rock in this same area, caused the original slope protection to be constructed of the inadequate pre-cast concrete blocks. Nevertheless the contractor for the recent work apparently believed he had located previously unknown sources of coarse gravel, which he immediately began to develop after the award of the contract. However, tests soon showed that gravel meeting the specified grading of ¼ to 2½ in. could not be produced without wasting 70% or more of the material, which actually contained less than 8% of gravel 1 in. or larger in size. Several pits were abandoned after trial before adequate sources of gravel were developed. All require heavy wastage and produce little gravel above the 1-in. size. The grading limits given in Table II were established by the engineer to govern specification requirements for filter-layer material.

These gradings, also plotted in Fig. 4, were believed to provide very reasonable limits within which the filter-layer materials should be graded to meet the requirements of such a layer and of the contract specifications. The contractor is meeting these requirements by mixing gravel and small quarry stone.

As of October 1, the contract work is 55% complete. While the filter layer and the rock riprap being placed under this contract have not yet stood the test of heavy wave action, it is believed that ample precautions have been taken to provide a permanent upstream-slope protection which will require little if any maintenance for many years.

George E. Johnson is chief engineer and general manager for the Central Nebraska Public Power and Irrigation District. Harry S. Mahood is project engineer, FWA. Col. William N. Carey (now Secretary, Am. Soc. C.E.) was chief engineer, FWA, during the period of investigation, development of the design, and commencement of the new construction. K. B. Keener and F. F. Smith, of the office of the Chief Engineer, Bureau of Reclamation; Joel D. Justin, consulting engineer, Philadelphia, Pa.; and George M. Shepard, consulting engineer, St. Paul, Minn., served as consultants to the FWA. Messrs. Johnson, Carey, Keener, Justin, and Shepard are Members, Am. Soc. C.E.

Modern Rigid-Frame Bridge Built by Seabees on Guam

By ARNOLD A. CLAUSEN, ASSOC. M. AM. SOC. C.E
LIEUTENANT COMMANDER (CEC), U.S NAVAL RESERVE

BACK in the prewar, pre-Japanese days on Guam, Agana was the principal town and center of activities of this little coral-island outpost. With a population of about 12,000 native Chamorros, Agana, like many old towns of Spanish origin, had the usual cathedral, plaza block, and narrow streets which meandered through the city with slight regard for symmetry. The main channel of the Agana River, a narrow little year-round stream, flowed for a considerable distance through the town and served to a large extent both as a source of wash water and as an open sewer.

In the bombardment preceding the assault operations on the island, practically all the town buildings were destroyed by naval gunfire. This left a free choice in rebuilding Agana along modern lines, and a layout has since been made according to which construction already has been started.

One of the first problems confronting the Fifth Naval Construction Brigade, which was charged with the task of building Guam into a major base, was to provide highways that would meet existing as well as future needs. These requirements were foreseen by Commodore W. O. Hiltabidle, Jr., M. Am. Soc. C.E., the officer then in charge of the Fifth Brigade, who had been stationed on Guam in prewar days. A highway location party from a Seabee unit was actually engaged in survey operations a few days after the assault forces landed, and the survey was well under way before enemy resistance had ceased.

SEABEES RELOCATE RIVER

As the program of island development progressed, the town of Agana became the center of three main highways involving a common intersection, the relocated channel of the Agana River, and a bridge. All three highways, as shown in an accompanying photograph, carry heavy traffic, the heaviest flow being along the four-lane shore route. Accordingly, the bridge erected as the focal point of this traffic pattern had to be designed for a heavy traffic flow and full four-lane width.

In prewar days, high water had been known to overflow the intersection area. Bridge headroom was, however, limited, because the grades could not be raised and still fit in with the adjacent streets. Since the length of the bridge had to conform with the highway layout, the problem was to provide a structure having a sufficient waterway and meeting the conditions of the three intersecting highways.

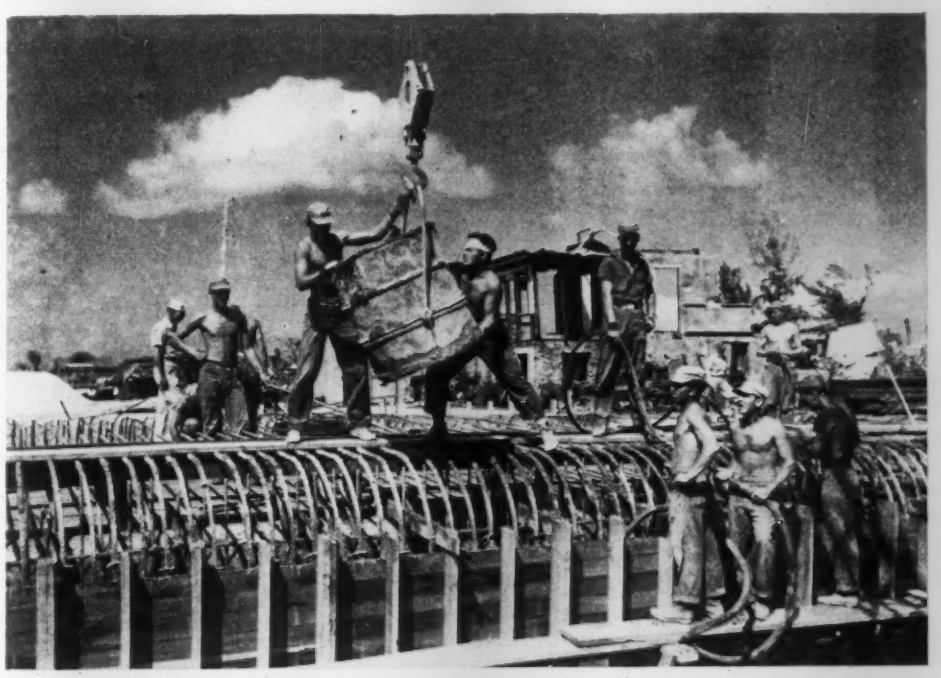
A test pit dug at the bridge site revealed coral of a limestone nature about where the bottom of the new channel would be, thus indicating a good foundation available.

To meet the existing conditions and to provide an unobstructed waterway at all stages of flow, a flat-slab rigid frame of reinforced concrete was considered best. As finally designed, this structure consisted of a rigid frame of 34-ft clear span, hinged at the base. The overall height was 12 ft 2 in. from top of footing to top of slab, with a roadway width of 76 ft from face to face of curbs, and with two 5-ft 6-in. sidewalks. An H-20 highway live load with 30% impact was used, with design stresses of 750 lb per sq in. for concrete and 18,000 lb per sq in. for reinforcing steel. (Stresses were computed by the method of moment distribution with an allowance for moments due to changes in deck length from temperature and shrinkage of concrete.)

A.A.S.H.O. SPECIFICATIONS PROVIDE DESIGN DATA

The only reference available for design purposes was a copy of the bridge design specifications of the American Association of State Highway Officials. The analysis of rigid frames with variable moment of inertia is a problem of some consequence even where complete design data are available, using such methods as moment distribution, column analogy, and slope deflections. To pick up these threads from past experience while engaged in military projects in a combat area is quite a different thing from the usual design office procedure. Suffice it to say that complete design calculations were made and checked. For this work, Lt. (jg) Ralph E. Scott, of the Fifth Brigade Planning Section, carried out the computations.

Since this bridge was in a town that was to be entirely rebuilt with due regard to modern trends in appearance,



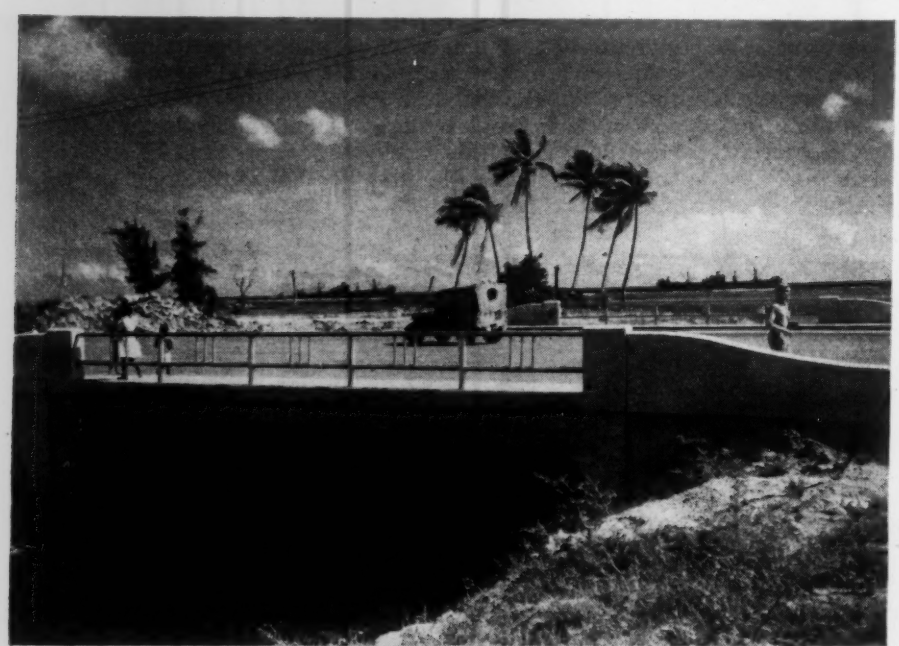
FIRST POUR UNDER WAY, INCLUDING SIDE WALLS UP TO CONSTRUCTION JOINT AT HAUNCHES

some attempt was made to provide a structure that would be in keeping with the future municipal development. This was accomplished by designing with graceful curved lines and simplicity rather than with an excess of artistic embellishment. The faces of all concrete were finished plain, and the handrail, made up of welded pipe, presents an appearance in keeping with this simplicity of design.

ONE OF GUAM'S BUSIEST HIGHWAY INTERSECTIONS—FINISHED BRIDGE SPANNING NEW CHANNEL OF AGANA RIVER

EX-MARINE SEABEES HANDLE FIELD WORK

The work was assigned to a versatile Construction Battalion, skilled not only in assault operations but in first-class bridge construction as well. This unit had seen almost two years of rough-and-tumble South Pacific service with Marine amphibious troops before coming to Guam. Even on this island, these Seabees had stormed ashore with the assault troops at Asan Beach and had cleared roads and patched old pre-war bridges to permit the Marine tanks to advance on Agana while the Japanese still held it. So it is somewhat remarkable that this same battle-scarred outfit, when given the opportunity, could fulfil the requirements of modern and permanent concrete bridge construction to put up a structure equal to anything built by contract under state-side conditions, where complete specifications and engineering inspection are provided.



SIDE VIEW OF COMPLETED BRIDGE WITH AGANA BAY IN BACKGROUND

Actual construction work, under the local field supervision of Lt. J. H. Gehring (CEC), U.S.N.R., Assoc. M. Am. Soc. C.E., was carried on without a mishap. Altogether, 510 cu yd of concrete and 86,000 lb of reinforcing steel were used. To provide this amount of material, as well as forms and heavy falsework, was a problem of major proportions at this advance base in the Pacific, where combat needs had first priority. Some substitution in sizes of reinforcing steel was necessary, but the work was carried out essentially according to plan.

Aggregates for concrete in Guam are obtained from reefs and deposits of coral, which differ in general appearance, specific gravity, hardness, and usefulness. Tests made from the better grades showed a crushing strength equal to, or greater than, 3,000 lb per sq in. Concrete used was made up of the better grade of limestone, crusher run, with some fine beach sand added, and its cement content was 7 bags per cu yd. Separate pours were made of the side walls to the construction joint at the haunch. The entire slab portion was placed in one continuous pour. The water content was held to the minimum consistent with workability. Vibrators were used in placing.

CARE AND SKILL REQUIRED IN BUILDING FALSEWORK AND FORMS

Special precautions were taken in constructing the falsework so that no settlement would occur. The resulting smooth lines of the finished concrete in the structure made this provision worth while.

Considerable skill was required in form building to produce the curved intrados, combined with a crown of 6 in. transverse to the center line of the bridge. The falsework was cut and set to computed elevations, and forms were checked before the pour was made. After two forms were stripped, an excellent rubbed finish was given to the handrail posts and exposed surfaces of the wing walls and frame.

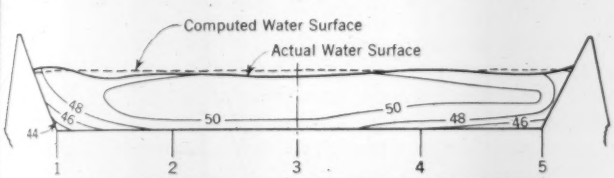
The finished work is equal in all respects to first-class state-side bridge construction and will remain a monument to this Construction Battalion, a unit which landed with the Marines on D-Day and held a beachhead during the first days of the assault. *Construmus battumus.*

Design of Spiral Spillway Chutes

By RAYMOND A. HILL, M. AM. SOC. C.E.,
CONSULTING ENGINEER, LOS ANGELES, CALIF.
and D. C. McCONAUGHY, SENIOR ENGINEER,
BUREAU OF RECLAMATION, DENVER, COLO.

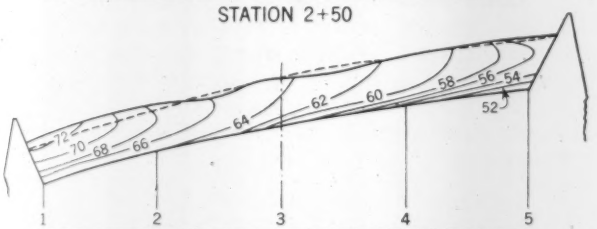
WHERE conditions require the construction of a spillway channel around the end of a dam, it is often possible to reduce costs considerably by designing the channel with horizontal curvature for the conveyance of water at high (supercritical) velocities. The bottom of such a chute must be superelevated to force the water to follow a curved path; such superelevation substantially reduces the depth of excavation which would otherwise be required.

The first known design embodying this principle was made in 1934, by Raymond A. Hill, M. Am. Soc. C.E., in connection with an application to the Public Works Administration for the construction of Bartlett Dam on Verde River as an addition to the works of the Salt River Project, a federal reclamation project. A year later, the Bureau of Reclamation adopted this basis of design after tests of hydraulic models, and so constructed the spillways at Bartlett Dam and at Stewart Mountain Dam in Arizona. Subsequently several more curved



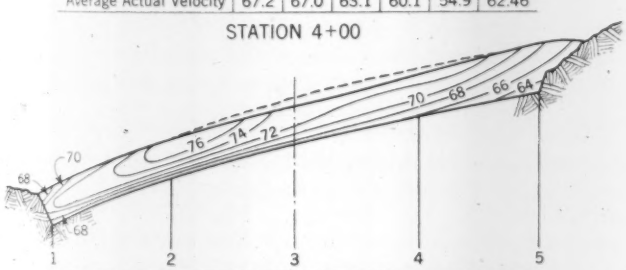
Section	1	2	3	4	5	Mean
Computed Velocity	49.3	49.3	49.3	49.3	49.3	49.30
Average Actual Velocity	47.3	50.6	50.8	49.7	48.5	49.38

STATION 2+50



Section	1	2	3	4	5	Mean
Computed Velocity	72.6	67.2	62.6	58.6	55.0	65.20
Average Actual Velocity	67.2	67.0	63.1	60.1	54.9	62.46

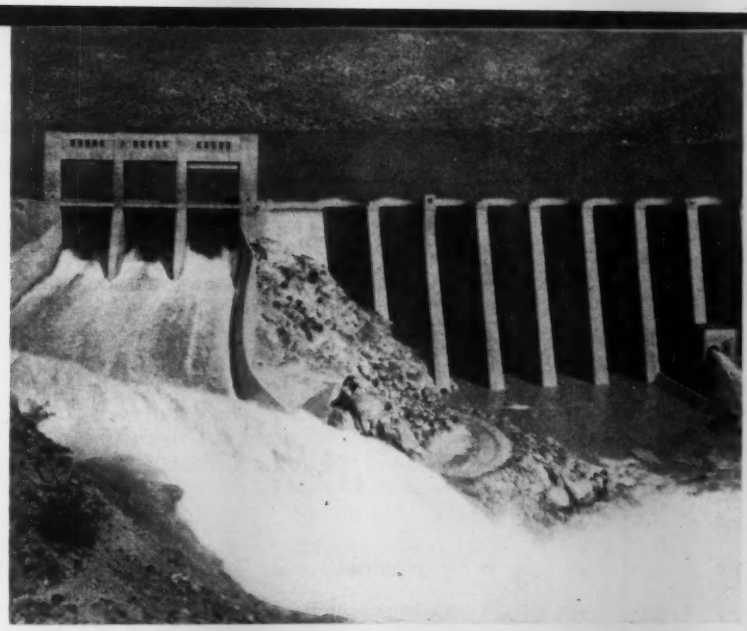
STATION 4+00



Section	1	2	3	4	5	Mean
Computed Velocity	79.0	72.9	67.0	63.4	59.5	68.36
Average Actual Velocity	71.0	73.5	71.7	70.1	66.0	70.46

STATION 7+00

FIG. 1. SECTIONS THROUGH BARTLETT DAM SPILLWAY LOOKING DOWNSTREAM, SHOWING COMPARISON OF COMPUTED AND ACTUAL VELOCITIES AT A DISCHARGE OF 175,000 CU FT PER SEC



BARTLETT DAM SPILLWAY, DESIGNED FOR DISCHARGE OF 175,000 CU FT PER SEC (DISCHARGE SHOWN IS ABOUT 6,000)

chutes of this type were built by the Bureau; others have been constructed under the direction of Mr. Hill.

In any such curved channel, for equilibrium, the centrifugal force acting on any element of volume of the water is balanced by a differential pressure due to the sloping water surface. For an element of volume, $dr\,dy\,dz$, at a distance r from the center of curvature, and for a velocity v, the centrifugal force is $(w/g)\,dr\,dy\,dz\,(v^2/r)$. For a static pressure head, h, the unbalanced static pressure is $w\,dh\,dy\,dz$.
Equating these expressions,

$$dh = -\frac{v^2}{gr}dr = -\frac{2h_v}{r}dr \quad \ldots\ldots (1)$$

For a free water surface, $dh = dh_v$, where h_v is the velocity head. Hence from Eq. 1 it follows that

$$vr = \text{constant} = K \quad \ldots\ldots (2)$$

which is the equation of a free vortex, and that

$$h_v r^2 = \frac{K^2}{2g} \quad \ldots\ldots (3)$$

which is the equation of the water surface across any radial section, h_v being the distance below the energy grade.

In the case of curved channels with parallel sides, it is assumed as a basis for proper design that all streamlines are concentric and that the discharge per foot of width remains constant. At any point in the channel, the distance from the bottom to the energy grade equals the depth plus the velocity head. Denoting this distance by y, and remembering that the depth is q/v where q is the discharge per foot of width, the following equation of the bottom with reference to the energy grade may be obtained from Eq. 2:

$$y = \frac{qr}{K} + \frac{K^2}{2gr^2} \quad \ldots\ldots (4)$$

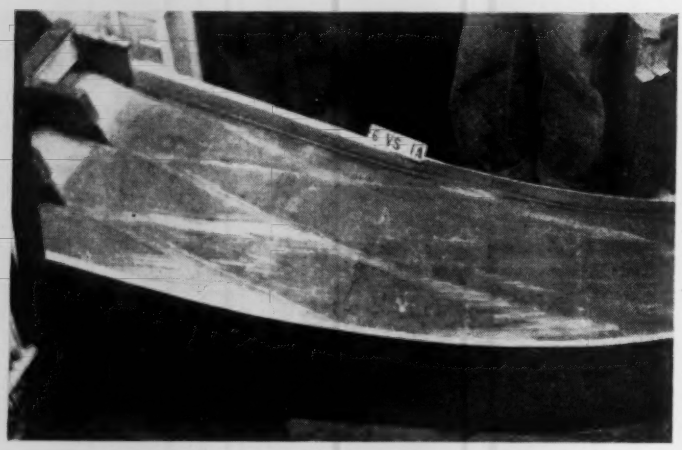
In actual practice there are certain features which limit the location and width, the curvature and superelevation, and the longitudinal slopes of the chute:

1. The location and width of the channel are generally determined by topographic conditions, by the quantity of water to be discharged, and by the depth of flow over the entrance weir or the height of the gates. Obviously, curved chutes are best adapted to gate-controlled spillways, because the velocity of flow below gates is little affected by the rate of discharge.

2. The curvature of the chute is determined largely by fitting the channel to the topography, with recognition of the fact that time is required for water to change its direction of flow.

3. Velocities higher than the critical must be maintained at all points, particularly along the outside of the curve, so as to avoid any tendency toward the formation of a standing wave.

The normal procedure in the design of a curved chute of any determined capacity is to select, subject to the preceding limitations, a simple radius of curvature of the center line and a profile of the upper side. The velocity at various points along the channel is then computed and the values of K in Eq. 2, and of $K^2/2g$ in Eq. 3, are determined for each radial cross section. The elevations of the bottom of the channel across such section are then



MODEL OF VALLECITO SPILLWAY AT DESIGN DISCHARGE OF 30,000 CU FT PER SEC

computed from Eq. 4. Successive trials are made in this manner, changing both plan and profile, until the channel is found which best satisfies the topographic and other conditions.

ATTENTION TO FRICTION

Up to this time, friction loss can largely be disregarded. In the final design, however, consideration must be given to the loss in energy caused by friction, and to the fact that such friction loss is greater at the inside of the chute than at the outside because of higher average velocities. Furthermore, as for any superelevated curve, spirals should be substituted for the simple curve assumed for approximation. Such spirals should be of a form convenient for purposes of computation, and commonly it will be found that conditions will be well satisfied if the radius of curvature of the entrance spiral is inversely proportional to the distance along the curve to some point where an exit spiral of decreasing curvature can be used. The values of K and of $K^2/2g$ are then redetermined for each cross section, and the elevations of the water surface and of the channel bottom across sections normal to the center line are again computed in the same manner as before.

In the development of Eq. 4, the static pressure was assumed equal to the depth, which is substantially true in most cases. However, occasionally it is desirable to begin the curve immediately below a weir, in which case the entrance spiral would be replaced by a variation in height of the weir above the channel bottom so as to give the proper velocities across the initial section. This might require a rather sharp curvature in a vertical plane, resulting in non-hydrostatic pressure distribution. The same effect may result from the use of a short horizontal radius requiring sufficient superelevation to produce marked vertical curvature in a longitudinal direction. Equation 4 can be modified to take account of the actual static pressures in such cases, but it is preferable to increase the radius of curvature of the channel enough to insure hydrostatic pressure distribution.

CHANNEL TAPERED

It is sometimes desirable to reduce the width of the channel below the spillway crest, for which purpose the channel is tapered. The sides then are not parallel and the streamlines are not concentric. However, the condition expressed by Eq. 1 is still valid; that is, that the transverse slope of the water surface at any point in a section substantially normal to the center line is equal to twice the velocity head divided by the radius of curvature of the streamline at that point. The values of these radii are known from the layout; if they are expressed mathematically as a function of the distance from the center line and substituted for r in Eq. 1, equations for the water surface and channel bottom may be obtained by integrating the resulting differential equation. Such a function, however, is usually complex and it is preferable to resort to graphical integration of Eq. 1, transposed to $dh_v/dr = -(2h_v/r)$. In making preliminary layouts, the streamlines at any section may be considered as concentric.

The final design can, of course, conform strictly to only one rate of discharge. This should be the largest quantity which the channel will be called upon to carry at reasonably frequent intervals. At times of greater flow, the quantity per foot of width will be a maximum along the upper side of the channel; when the discharge is below the design rate of flow, water will tend to concentrate toward the inside of the curve. However, from model tests, and from observations of actual flow through such spillways, it is evident that spiral chutes so designed are less sensitive to changes in the rate of discharge than might be expected. Rarely will it be found necessary to increase the height of the wall along the lower side to accommodate low discharges. It has been found advisable, however, unless the lining extends to a point at which the channel bottom is substantially level normal to the center line, to end the lining on a diagonal line by extending the upper side of the channel beyond the lower side so that when the water leaves the pavement it will necessarily flow away from, and not along, the end of the floor lining.

COMMENTS ON RESULTS OF MODEL WORK

Comparisons between the computed water surfaces and velocities for the spillway of Bartlett Dam and the corresponding surfaces and velocities determined from model tests are shown in Fig. 1. The prototypes of the Bureau of Reclamation designs, so far as can be judged from the few times of actual flow through them, behave as the hydraulic models indicated they would.

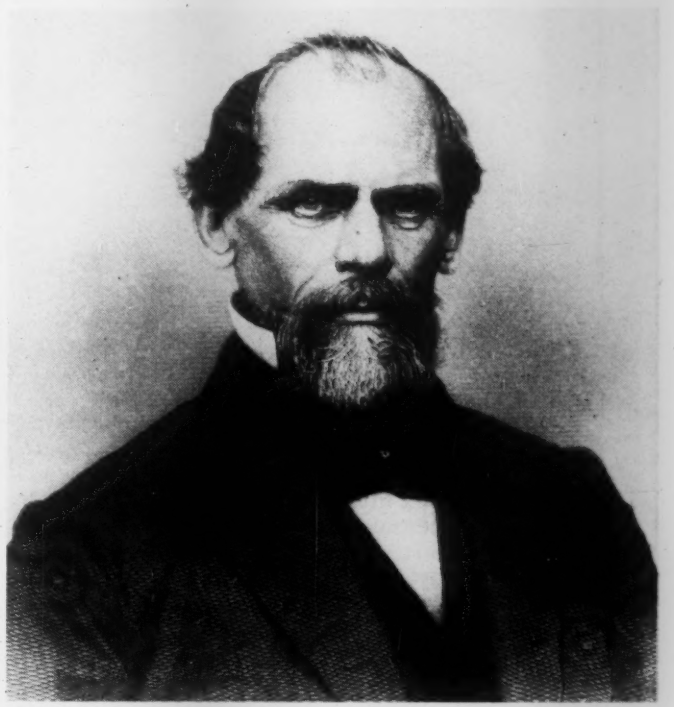
Model tests of most of the designs by Mr. Hill were made either in the hydraulic laboratory of the California Institute of Technology or in that of the U.S. Engineer Department in Los Angeles. Model tests of Bureau designs were conducted in the hydraulic laboratory of the Bureau of Reclamation at Denver, Colo. Bureau designs and investigations were made under the direction of J. L. Savage, Hon. M. Am. Soc. C.E., Chief Designing Engineer. At the time these studies were made, S. O. Harper, M. Am. Soc. C.E. was Chief Engineer of the Bureau of Reclamation. H. W. Bashore, M. Am. Soc. C.E., is Commissioner of Reclamation.

Design of Bridges Against Wind

II. *Aerodynamic Instability—Historical Background*

By D. B. STEINMAN, M. AM. SOC. C.E.
CONSULTING ENGINEER, NEW YORK, N.Y.

FOR a century and a quarter, aerodynamic instability has been an engineering problem. Of course it was not so understood. Earlier engineers simply knew that suspension spans were particularly prone to disaster by wind. Modern investigation indicated the underlying cause—a progressive amplification of harmonic undulation due to wind, finally becoming destructive. An account of the history of this difficulty, as exemplified by actual structures, and culminating in the Tacoma disaster, is given in this second article by Dr. Steinman. In effect it is an introduction to the more detailed study of the principles involved, to follow in the next article of the series.

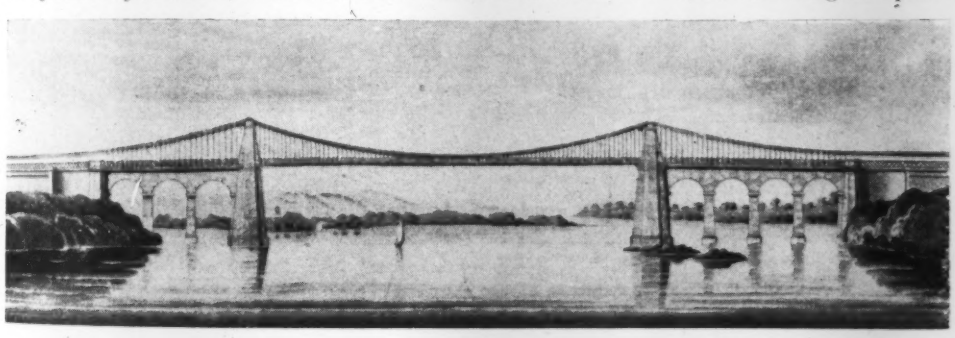


JOHN A. ROEBLING, PIONEER IN SUSPENSION BRIDGE BUILDING AND CABLE MANUFACTURE

EARLY suspension bridges, built before 1840, were light, flexible structures, at the mercy of the wind. The experience of those spans remained, for a century, a forgotten chapter in bridge engineering history.

One of the earliest chain spans was the Dryburgh Abbey Bridge across the Tweed in Scotland. It was a footbridge of 260-ft span. Built by John and William Smith in 1817, it was completely destroyed by a gale within a few months.

A pioneer builder of suspension spans in England was Sir Samuel Brown, but a whole string of his chain bridges—at Berwick, at Brighton, and at Montrose—were wrecked by wind action. In 1819–1820 he built the Union Bridge over the Tweed at Berwick, with a span of 449 ft—the first highway suspension bridge in England—but within six months it was destroyed by the wind. His Brighton Chain Pier (a series of four spans), built in 1823, was partially wrecked by a storm in 1833; and after reconstruction, it was dramatically wrecked again by aerodynamic action in 1836. Sketches made by a competent eyewitness show the characteristic sine-curve oscillations culminating in catastrophic torsional motion. The Montrose Bridge in Scotland, built by Brown in 1829, partly collapsed (from overloading) in 1830, with great loss of life. After repair, it was wrecked by a gale in 1838. Eyewitnesses saw the span undulating in two segments before the failure.



TELFORD'S FAMOUS MENAI STRAITS SUSPENSION BRIDGE
From Old Engraving in T. G. Cumming's *Iron Bridges of Suspension*, London, 1824

The world-famous Menai Straits Bridge in Wales, with a record span length of 580 ft, built by Thomas Telford and opened in January 1826, was subject to alarming aerodynamic undulations. The span undulated in waves 16 ft high (including torsional oscillations). The bridge was injured by such wind action in 1826 (one month after completion), and again in 1836 and 1839. It had to be largely rebuilt after the gale of 1839.

A German span, the Nassau Bridge over the Lahn River, built in 1830, was severely damaged by wind (chains and floor broken) in 1833. The Roche Bernard Bridge in France, built in 1840 (using wire cables) with a record span of 641 ft, was wrecked by wind in 1852, when the suspended roadway dropped into the river.

The Wheeling Bridge over the Ohio River, of 1,010-ft span, built by Charles Ellet in 1848–1849, and at that time the longest span in the world, was violently and dramatically wrecked by aerodynamic action in 1854. It was reported at the time that the previous accustomed undulations suddenly changed to violent twisting oscillations—"lunging like a ship in a storm," "each vibration giving it increased momentum"—until the span overturned as the south group of cables snapped. The structure dropped into the Ohio, a wrecked and twisted mass of wire and timber.

The Lewiston-Queenston suspension bridge over the Niagara River, with a new record span-length of 1,043 ft, built by Edward W. Serrell in 1851, was nearly wrecked in a gale in 1855. Under-floor stays were added, but in 1864, when the stay-ropes were left temporarily disconnected, the bridge was destroyed by wind action. The damaged cables were left dangling for 34 years as the sole remains of the wreck, a silent reminder of nature's power and man's forgetfulness.

ROEBLING'S NIAGARA RAILWAY BRIDGE, FIRST SUSPENSION STRUCTURE FOR THIS USE

The first Niagara-Clifton Bridge at Niagara Falls was a highway suspension structure with a new record span-length of 1,268 ft. It was built by Samuel Keefer in 1868. Rebuilt by G. W. McNulty in 1888, it was completely destroyed by wind action seven months later. This occurred during the night of January 9, 1889. A physician making the perilous trip across the span at midnight described the bridge as rocking "like a boat in a heavy sea," tipping up "almost on its very edge." In the morning no trace of the span was left; it had been torn away from the cliffs as though cut off by a giant knife, and the entire crumpled mass of steel and wire lay bottom up, beneath the deep, turbulent waters of the river in the gorge below. The story of this bridge failure was somehow suppressed, and hardly even mentioned in engineering literature. A new span was quickly fabricated and erected to replace the old one before it could be missed by the summer tourists.

There are other dynamic effects that make it necessary for bridges to have adequate stiffness. Span rigidity is demanded to resist cumulative amplification of oscillations—whether caused by wind action or by live load. The familiar rule that troops must break step when crossing a bridge was a lesson learned from early disasters. In 1831 the Broughton Bridge in Lancashire County, a chain bridge only two years old, crashed under a body of marching troops, and in 1850 a wire bridge of 335-ft span, at Angers, France, collapsed under a similar load. A chain bridge at Ostrau, Czechoslovakia, built in 1851, collapsed in 1886 from the dynamic effects of a detachment of cavalry crossing the span.

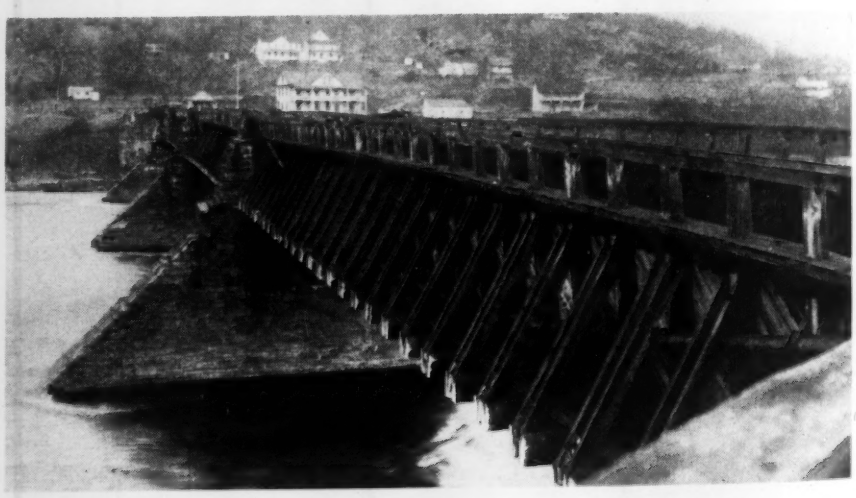
At the entrance to the lower deck of Roebling's Niagara railway suspension bridge (1855), this notice was posted:

> A fine of fifty to one hundred dollars will be imposed for marching over this bridge in rank and file, or to music, or by keeping regular step.

In an unstiffened span, any loading tending to set up harmonic undulations may have serious results. The Schuylkill Falls Bridge in Philadelphia, one of the pioneer chain bridges built by James Finley, lasted only two years, collapsing in 1811 under a drove of cattle. The Yore River Bridge in Yorkshire, built in 1830, collapsed a few months later also under a load of cattle. A chain bridge built in 1830 by Sir Samuel Brown to carry the Stockton and Darlington Railway over the river Tees in Durham County, England, was progressively destroyed within a few years by excessive deflections under the loads of passing engines. The Ballock Ferry Bridge near Loch Lomond in Scotland, built in 1842 by James Dredge, failed (according to one account) in 1850 under a flock of sheep. In 1854, a suspension span over the Licking River, from Covington to Newport, Ky., suddenly collapsed under a passing drove of cattle, only two weeks after it was opened.

It seems that the lessons of this long list of bridge failures were forgotten by the profession. At least they were until modern bridge engineers were dramatically reawakened to the problem by the catastrophic failure of the 2,800-ft span of the Tacoma Narrows Bridge (the third longest span in the world) on November 7, 1940, only four months after its completion.

Technical literature, prior to 1940, gave little reference to such disasters. The Wheeling Bridge catastrophe in 1854 was briefly dismissed as simply another failure caused by a storm. The only engineer of the time who grasped its full significance was John A. Roebling. With intuitive genius, a century ahead of his time, he realized the need of bracing and stiffening suspension spans against cumulative undulations that may be started and amplified by the action of the wind. In his pioneer article on the subject, inconspicuously published in the *American Railroad Journal* in 1841, and thereafter overlooked by the profession, he discussed the weaknesses of earlier suspension bridges, their vulnerability to destructive cumulative vibrations, and the proper corrective measures to insure the safety of future spans. And in his very first bridge, the multiple-span Monongahela Bridge in Pittsburgh (at Smithfield Street), built in 1845, he provided special means for stiffening the spans. Both stiffening trusses and inclined stays were incorporated from the start, in 1850, in his design for the 820-ft-span Niagara railway suspension bridge, completed in 1855. On March 16, 1855, the first train passed over the com-



AN EARLY ROEBLING SUSPENSION STRUCTURE—AQUEDUCT OVER DELAWARE RIVER AT LACKAWAXEN, PA.

ROEBLING'S DREAM—ORGIINAL DESIGN FOR THE BROOKLYN BRIDGE

pleted structure—the first train in history to cross a bridge suspended from wire cables. And to the amazement of the public and of the profession, the span of wire and wood did not collapse.

FIRST SUSPENSION BRIDGE WITH STIFFENING TRUSSES

In another sense bridge engineering history had been made. The Niagara span was the first suspension bridge ever built with stiffening trusses. This was a major contribution to bridge engineering—the first radical improvement in the suspension-bridge art in two thousand years. The full potentialities of the suspension type could not be realized as long as it continued to be represented by swaying, undulating structures. As Roebling expressed it: "Suspension bridges have generally been looked upon as loose fabrics hung in the air, as if for the very purpose of swinging. Repeated failures of such works have strengthened this belief." Even in his earliest spans, this master builder grasped the fundamental importance of adequate stiffening. His success (1845–1850) in the construction of suspended aqueducts —"as rigid as stone or cast-iron aqueducts"—demonstrated the truth of his thesis that cable spans could be built as stiff as desired. In those canal structures, his solidly braced flumes supplied the stiffening element.

In his first highway structure, the Monongahela Bridge at Pittsburgh, he made the outside railings or "parapets" in the form of latticed trusses, which served to some extent as stiffening elements for the suspended spans—forerunners of real stiffening trusses. In his Niagara railway suspension bridge, filling the vertical height between the upper and lower decks of the 820-ft span, this trussed bracing was 18 ft deep. The amazing success of this radical innovation established it thereafter as a recognized essential feature in the design of suspension bridges.

Until it had to be replaced in the march of progress, this Niagara span carried the increasing weights of locomotives and trains for 42 years, while other bridges built over the Niagara River by Roebling's rivals were being blown down by the wind. By providing inclined stays and stiffening trusses, Roebling secured for his bridges a new high measure of safety and stability against the forces that wrecked the weaker spans built by his contemporaries.

In the Niagara achievement, Roebling developed and introduced features of suspension-bridge design that assured strength, rigidity, and stability, not only against the useful loads to be carried but also against the potentially destructive forces of wind and storm. This pioneer gave these principles to the profession, in his published account of the work and in his printed reports, but the profession forgot his teachings, only to rediscover them three generations later at great cost.

In his Ohio River Bridge at Cincinnati, completed in 1867, establishing a new record span-length of 1,057 ft, Roebling added something new and significant—cable stays, running diagonally upward from the stonework of the towers to points of the cables in both main span and side spans. Their purpose, as stated in the engineer's report, was to check aerodynamic oscillations.

Perhaps the most distinctive feature of his Brooklyn Bridge is the system of inclined stays radiating downward from the towers to the floor of the span. The magic of the resulting weblike tracery of lines has been the delight of artists and poets, and of all who love beauty. But these radiating lines were not gratuitously added for artistic effect; the genius of Roebling introduced them primarily for the critical function of adding rigidity and assured aerodynamic stability to the span. He then took advantage of the additional load-carrying capacity which they incidentally supplied.

AN IMPORTANT CONTRIBUTION

Roebling taught the profession the importance of stiffening suspension spans, and he showed the world the effectiveness of such stiffening. For half a century thereafter this basic idea was recognized and governed suspension-bridge design, producing structures of a new order of stability and longevity. Stiffening trusses were made deeper and deeper, reaching a climax in the obviously excessive proportions of the Williamsburg Bridge in 1903, with its truss depth equal to $1/40$ of the span length.

Thereafter, with the swing of the pendulum, the trend was reversed. The introduction of the "deflection theory" for suspension-bridge design revealed that some of the prior spans had been proportioned with needlessly excessive depth and section, and placed a premium of economy on more flexible design. Increased emphasis on artistic appearance placed a further premium on grace and slenderness. Stiffening trusses were made shallower and shallower in depth. Towers were reduced to more and more slender and flexible forms. Then, commencing about 1930, with such effective examples as the self-anchored spans over the Allegheny at Pittsburgh (1926–

CINCINNATI BRIDGE, FORERUNNER OF ROEBLING'S MORE FAMOUS BROOKLYN SPAN

1928) and the 1,033-ft span of the Cologne-Mühlheim Bridge over the Rhine (1929), the use of stiffening girders instead of trusses acquired increasing applications, resulting in maximum artistic simplicity of line.

Thus improvements in analysis, in economy, and in aesthetics—all combined to accelerate the trend toward increased slenderness of proportions. Engineers began to forget or to discount the principles that Roebling's genius had evolved and demonstrated. With more mathematics than the pioneer master builder had available in his time, but with less native intuition and constructive perception, a later generation of designers carried the reversed trend to a climax until they were awakened by the impact of catastrophe—the destruction of the Tacoma Narrows span, by aerodynamic oscillations, in a mild gale on November 7, 1940.

The Tacoma Bridge was adequately safe for all the loads and forces for which it had been designed, namely, dead load, live load, temperature, and the static effect of wind load. It had not been designed, however, for the dynamic effect of wind load. By dynamic effect we mean the effect of a steady wind, acting on a flexible structure of conventional cross-section, to produce a fluctuating resultant force automatically synchronizing in timing and direction with the harmonic motions of the structure so as to cause a progressive amplification of those motions to dangerous or destructive amplitudes.

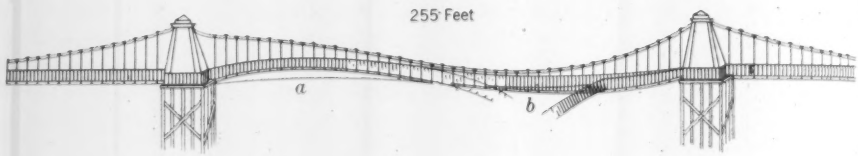
On the morning of the Tacoma failure, the gale of 35 to 42 miles an hour meant a wind pressure of little more than 5 lb per sq ft. The bridge had been designed for a wind pressure of 50 lb per sq ft, and was structurally safe for a static wind load of 50 lb per sq ft. It was destroyed, however, by the cumulative dynamic effect of the vertical components produced by a wind pressure of 5 lb per sq ft.

Thus the Tacoma span was the victim of its extreme flexibility and of the vulnerability of its cross-section to the creation of resultant wind forces producing cumulative amplification of oscillations. This combination constitutes aerodynamic instability.

In report after report Roebling proclaimed, and in span after span he demonstrated, that suspension bridges can be built with any desired degree of rigidity. He also pointed out the danger of whittling down span cost by sacrificing span stiffness. A later generation, reversing the emphasis, preached economy through flexibility. But no one knew how far it was safe to go. Where should the line be drawn to separate adequate from inadequate stiffness? The answer to this question was lacking.

Now we have the answer. Eight or more bridges completed since 1930 have rigidity coefficients below a certain value; these spans have manifested various degrees of aerodynamic instability; four of these bridges, completed in 1938 and 1939, have required stays to check their undulations. Then came the Tacoma Narrows Bridge, completed in 1940; this span had a still lower coefficient of stiffness, and it succumbed to the consequences of its extreme flexibility. Hence now we know where to draw the line: Below a certain measure of stiffness, we may expect some difficulties requiring corrective measures; and if we go below a still lower indicated ratio, we may expect disaster (unless the aerodynamic stability of the structure is otherwise assured).

Attacking the problem from the other end, that is, scientifically eliminating the cause instead of mechanically resisting the effect, we have now found that certain shapes and proportions of sections minimize the potential aerodynamic action; and we have demonstrated that cross-sections can be designed that will yield assured aerodynamic stability, even in the longest spans. A most promising field for further research has been opened; a new science has been created.



CHAIN BRIDGE FAILURE AT BRIGHTON, ENGLAND, 1836
Sketch Shows Greatest Movement Before Collapse; the Under Surface of the Roadway Was Visible at *a* at the Same Time as the Upper Surface at *b*

The profession has learned its lesson from the Tacoma failure. Bridge engineers have been awakened to think in terms of aerodynamics and of dynamic vibrations, and to test and analyze these phenomena as applied to bridges. The profession has learned the necessity of combining its knowledge of aerodynamics, of structural design, and of mechanical vibrations—and of applying a combination of the three to ensure the safe design of the great bridges of the future.

Such is the price we pay for progress. The great advances of the human race have been made by those who had the courage to go beyond the charted course. It is only in such manner that new knowledge can be gained, that new progress can be achieved. When progress is too rapid, we may expect to stumble. The test of man is that he profits by his experience and continues onward, with new wisdom and knowledge, toward still greater conceptions and achievements.

(Parts of this second article, including a number of the illustrations, is excerpted from the author's book, The Builders of the Bridge, *Harcourt, Brace and Company, 1945.)*

Seabees Encounter Unusual Soils on Iwo Jima

Airfield Construction as Affected by Volcanic Conditions

By F. B. Campbell, M. Am. Soc. C.E.
and W. K. Chase, Jun. Am. Soc. C.E.

Respectively Lieutenant Commander and Lieutenant (jg), Civil Engineer Corps, U.S. Naval Reserve

THE island of Iwo Jima—"Sulfur Island"—is of recent volcanic origin. It is about 5½ miles long from Mt. Suribachi at the southern tip to the northern end of the broad plateau. At its widest dimension, the island is about three miles across. Mt. Suribachi rises abruptly 540 ft above the Pacific, and the plateau has an average elevation of 340 ft.

The island is composed of volcanic ash in two forms—a loose black cinder commonly referred to as black sand, and a consolidated buff-colored ash sometimes called sand-rock. Outcroppings of hard igneous rock are found at the base of Mt. Suribachi and near the northeastern edge of the island. The soil is sufficiently fertile to support vegetation, and there is adequate rainfall for plant life.

Iwo Jima is in an active seismic region. The Japanese experienced numerous earthquakes during their tenure, and one of the small volcanic craters has been known to erupt several times. Steam is commonly seen issuing from the many fumeroles on Mt. Suribachi and on the plateau. This is most often observed after heavy rains have penetrated the porous soil. Water pumped from the ground-water table has a temperature ranging from 130 to 140 F. The virgin ground in shallow excavations is warm to the touch nearly everywhere on the island. Temperatures taken in deeper excavations have ranged from 110 F to 208 F.

HIGH SAND FILLS POSSIBLE

With certain minor exceptions, Iwo Jima is ideal for the construction of airfields. The black sand makes excavation easy with modern tractor-drawn scrapers and produces an inexpensive and stable fill. The high sand fills built by the Japanese have shown no evidence of settlement. The grains are porous cinders generally angular in shape and should have a fairly high frictional resistance in any shear plane. Embankments of this material are porous enough to drain well. An interesting characteristic of the black sand is its magnetic properties; particles are attracted by a horseshoe magnet. A simple test on several samples showed that an average of 5% by weight of the particles have this magnetic property.

The buff-colored volcanic ash was found to be well suited as a "clay" surfacing for air strips and roadways. The Japanese had used it extensively on the runways. The material was easily excavated with a power shovel. Some deposits could be excavated with tractor-drawn scrapers. In some locations it was necessary to use a pusher tractor for loading, and in many cases the material was loosened with a heavy rooter. A layer of this material at least 12 in. thick was placed on all black-sand fills. This course was rolled with a sheepsfoot and then bladed and smooth-rolled to grade. It formed a fair surface for emergency airstrip operation except for the dust during dry periods. Repeated sprinkling with sea water was found to be a good dust palliative. The buff material thus placed proved to be a suitable base for the bituminous paving which was added later. The material had little stability when the optimum moisture content was exceeded, and in some instances there were subgrade failures from excessive moisture. But when properly placed, drained, and thoroughly compacted, the buff-colored volcanic ash makes an excellent base.

Rock is available on the island both as boulders and as igneous outcrops. When crushed and screened, it made good aggregate for bituminous concrete, and a good base course at locations with doubtful bearing values. The rock varies from a dense, solid porphyritic structure to a porous vesicular rock.

Sufficient tests were made in the soil laboratory to determine general properties. The occurrence and use of the two predominant types of material have been described. In addition to the black sand and the buff ash there were occasional deposits of a partly consolidated blue volcanic ash and a loose, powdery, gray volcanic ash. The blue ash afforded a very firm compacted fill; the gray ash was so dry and powdery that only a light fill could be obtained, and this material was wasted. All soils tested were first washed through a 200-mesh sieve. As no hydrometer equipment was available to determine the grain-size distribution of the finer fraction, only the sieve analysis is given in Table I. It is to be noted that the black sand is of a fairly uniform grain size. The buff ash, while in a finer category, shows a better distribution of grain sizes.

Proctor moisture-density tests were made on a sufficient number of samples to establish typical curves for the four types. As may be expected, the black sand showed a flat moisture-density curve with a low optimum moisture and the highest maximum density of 105 lb per cu ft. Even this is a low density compared with that of 110 to 120 lb per cu ft for normal soils. The buff ash was

Tractor-Drawn Scrapers Carve a Runway Out of Iwo Jima's Steaming Sands

VOLCANIC ASH COMPACTED TO FORM AIRSTRIP SURFACING ON IWO JIMA

lower still, with a maximum density of 87 lb per cu ft, and required 27% of water for optimum moisture. The particles of the gray ash appear almost entirely micaceous when viewed under the microscope. A comparison of laboratory tests is given in Table I.

Plasticity needle tests were made on the buff ash and the blue ash. These tests were consistent with previous experience, showing a needle reading of approximately 900 lb per sq in. at optimum moisture. This phenomenon affords an excellent method of controlling moisture on the job. Samples are taken from the embankment and compacted in the cylinder for needle readings. If the material is dry, water should be added until the plasticity

TABLE I. LABORATORY ANALYSES OF SOILS ON IWO JIMA

VOLCANIC MATERIAL	MECHANICAL ANALYSIS: % Passing 200 Mesh	MECHANICAL ANALYSIS: 50% Grain Size, Mm	PROCTOR TEST: Max. Density Lb per Cu Ft*	PROCTOR TEST: Opt. Moist. %	PROCTOR TEST: Plasticity Lb per Sq In.†
Black sand	1	1.3	105	13	...
Buff ash	26	0.17	87	27	900
Blue ash	29	0.40	93	22	900
Gray ash	34	0.23	64	38	...

* Based on dry weight.
† Arbitrary value consistent with test data.

needle readings drop to 900 or 800 lb per sq in., which indicates the optimum moisture or the required amount of water for maximum density. With a smaller quantity, there is inadequate water to lubricate the particles during rolling or other compaction processes. With a greater moisture content, the surface tension of the water forces the grains apart and results in a lower density. Furthermore, in some soils, water added beyond the optimum will make a muck and bog down the wheeled equipment.

The buff-ash borrow pits at Iwo Jima all had an optimum moisture content or greater. The very high heat underground caused steam to form from the ground water, and this steam was a continuous source of moisture in the borrow pits or excavations. The moisture averaged 36% in the borrow pits, but this percentage dropped to 30% in the embankments owing to evaporation. Since the optimum moisture content was only 27%, it was not necessary to add moisture for compaction purposes. In some cases the moisture was too great because of heavy rains, and at some localities soft material had to be removed. The natural density of the material as it lay in the borrow pit averaged 65 lb per cu ft. This density was increased by compaction to 72 lb per cu ft in the fill. The maximum laboratory density was 87 lb per cu ft, but this is never attainable in practice for the simple reason that the laboratory density is obtained by compaction in a steel cylinder, whereas compaction in an embankment occurs in a yielding or plastic mass.

After paving had started, a few foundation failures occurred. These were corrected by cutting out the paving, removing the soft material underneath, and replacing with crushed rock and patching. In nearly every case of failure, the softness of the subgrade could be attributed to the trapping and condensation of steam under the paving. At one location where a deep soft spot was in evidence before paving, an 8-in. hole was bored into the ground. Into this hole a 3-in. perforated pipe 10 ft long was inserted and the outside packed with gravel. Twenty-four hours later the pipe was sounded and 6 in. of condensate was found to have collected in the bottom. One large soft area about 15 by 40 by 12 ft deep was removed and filled with boulders. Another very large area which was quite hot was undercut about 12 in. and refilled with crushed rock. None of the areas especially treated has shown signs of failure. Moisture checks made on three small areas that failed revealed an average of 35% moisture in the subgrade.

BORROW PITS YIELDED MATERIAL AT TEMPERATURES RANGING UP TO OVER 200 F

The work performed by the Seabees on Iwo Jima was under the command of R. C. Johnson, Commodore, CEC, U.S.N.R., and P. F. Henderson, M. Am. Soc. C.E., Commander, CEC, U.S.N.R. The test work generally described here was done under the direction of F. B. Campbell, M. Am. Soc. C.E., Lieutenant Commander, CEC, U.S.N.R., and the tests were conducted by W. K. Chase, Jun. Am. Soc. C.E., Lieutenant (jg), CEC, U.S.N.R. The statements herein are those of the authors and do not reflect the policy or opinion of the Navy Department.

Express Highway Connects São Paulo, Brazil, with Port of Santos

By Ariovaldo Vianna

Director, Department of Highways, State of São Paulo, São Paulo, Brazil

Foremost accomplishment of Brazil's highway program has been construction of the Via Anchieta, an express highway connecting São Paulo with Santos, about 35 miles distant. Both design and construction are unusual in certain elements because of difficult terrain and varying foundation conditions. One example was the use of sand piles in consolidating subgrade. Director Vianna has announced this to be a part of a 20-million-dollar highway program in the State of São Paulo, to be completed in the year 1946.

Located on the coast of Brazil, but 35 miles from São Paulo, is the port of Santos, third largest port in all South America. Transportation between the two cities has in the past been accommodated by two railroads and a narrow precipitous highway, unpaved for the greater part of its length. Despite its difficult characteristics, the highway carried an ever-increasing amount of the traffic. To provide a more adequate traffic artery, the State of São Paulo in 1940 commenced construction of a multiple-lane express highway to be called the "Via Anchieta."

From its starting point in São Paulo, the highway crosses three distinct topographical areas: a plateau, a rugged "Serra," and the coastal plain. The plateau extends to 25 miles from the state capital and is characterized by rolling country between altitudes of 2,300 and 2,600 ft above sea level, and by natural irregularities of minor importance. It presents three important stream crossings requiring special engineering work. These are over small watercourses which have grown in volume in consequence of the Rio Grande Reservoir, formed for the largest hydroelectric plant in the country.

The Serra is a 2,400-ft abrupt rise connecting the coastal plain and the interior plateau. This natural feature, which extends along the major part of the coast line of the country, possesses historical significance as an obstacle to the penetration of the hinterland.

The highway extends 8.14 miles up this escarpment on steep ground, with side slopes as steep as 60°, covered by dense vegetation. The topographic conditions demanded special study and numerous concrete structures. It was necessary along most of the Serra section to build two two-lane highways, at different levels, one for ascending and the other for descending traffic. These two highways follow generally along the side hills and are approximately parallel.

In the Serra region, the rainfall is very abundant, reaching on an average 170 in. annually. This quantity, which represents the average over 15 years (there have been years of 276 in.), shows how unfavorable the local meteorologic conditions are for highway work. The fog, which is heavy almost all the year round, is also a hindrance and will require illumination of the highway.

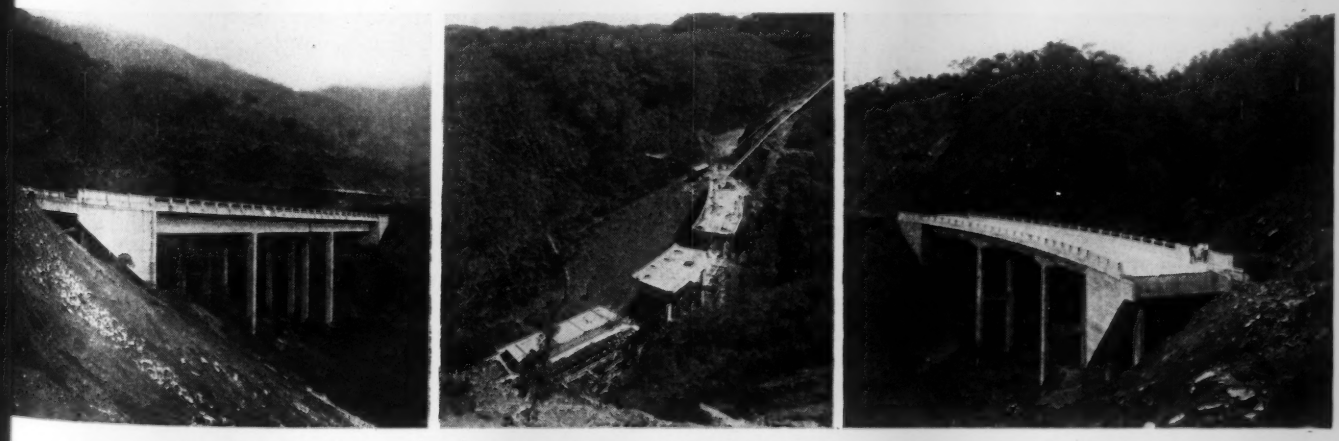
Between the Serra and the sea lies the coastal plain. It is $7\frac{1}{2}$ miles across, of alluvial formation gently sloping toward the sea, and cut by a network of irregular and extremely tortuous watercourses. The land is low and swampy and is subject to the influence of the tides right up to the foot of the Serra.

The entire plain is formed by a deposit of organic material lying over layers of sand alternating with organic material, on a rocky stratum. Geological conditions demand special foundation treatment for work in this section. Two important watercourses, one at the foot of the Serra and the other near the sea, are spanned in this section. The latter is an arm of the sea separating the island of São Vicente, on which the city of Santos is situated, from the continent.

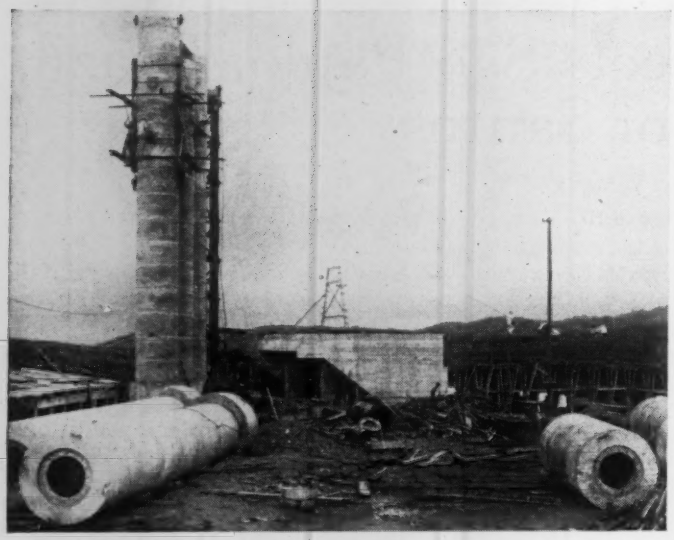
Features of the Highway

Both on the plateau and on the coastal plain, the Via Anchieta consists of two concrete strips each 23 ft in width, separated in the center by a 10-ft turfed parkway. On each side there is an 8-ft shoulder for parking which ends with the slope on embankments, or with a ditch in the case of cuts.

The concrete strips slope from the center line on a $1\frac{1}{2}\%$ grade toward each side. On the shoulders, the surfacing consists of an asphalt treatment, and the slope reaches 5.3%. The center parkway is crowned, connecting with the 1.5% side slopes of the paving. It is formed by a layer of humus placed over the impermeable soil, which is heavily compacted and cut in a "V" with two



Numerous Viaducts of Reinforced Concrete Were Built in the Mountainous Section



PIERS FOR THE RIO PEQUENO BRIDGE WERE FOUNDED ON CYLINDRICAL CONCRETE CAISSONS

10% slopes, converging toward the center line. In the middle, a longitudinal drain collects rain water filtering through the turf. This water is discharged at intervals by cross drains.

In the section subject to erosion either because of the nature of the soil or the steepness of the slopes, the ditches are completely lined. They consist of two concrete pre-cast slabs, of different widths, joined into one piece by means of a concrete block. This block is cast in place and forms the bottom of the ditches.

The cuts rise from the roadbed gently, on a slope consistent with their height, and are turfed. Beginning at a point a third of their height up, the slopes are curved to meet the natural surface. This shape is essential, owing to the marked improvement afforded to the cross section. In addition to giving greater stability to the slopes, this shape increases the insolation of the roadbed, improves visibility, and contributes in an effective manner toward harmonizing the landscape with the surrounding topography. These effects can already be appreciated in that part of the highway open to traffic.

The total width of the roadbed in cuts is 83 ft, and on embankments 73½ ft. On the Serra up to El. 362 ft, the cross section is the same as on the plateau and on the coastal plain, but the center grass strip is replaced by a concrete traffic separator 1 ft 8 in. wide. The width of each shoulder is reduced to 3 ft 4 in. In the remaining part of the Serra, the cross section of each road is 31 ft 6 in. wide, the concrete paving being 23 ft wide.

Different conditions were fixed for the Serra, and for the plateau and coastal plain sections, according to the two basic speeds established—47 and 65 miles per hr, respectively. Studies were made regarding the effects of visibility, grade steepness, and skidding, in relation to these speeds.

STABILIZATION OF FOUNDATIONS

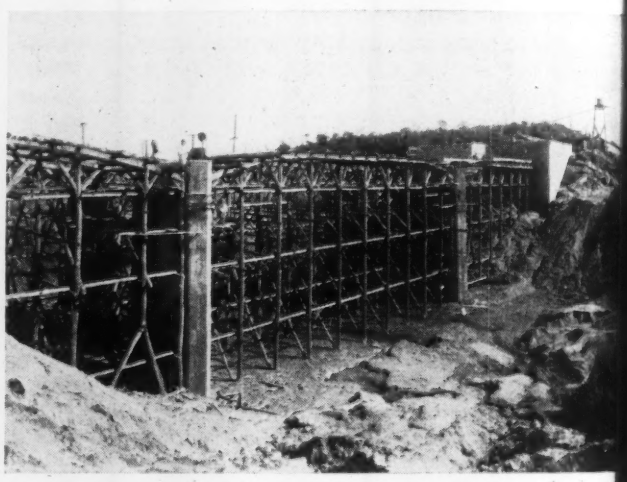
Based on the results of borings and tests, adequate treatment was applied to the soil of the foundations. This treatment varied from a simple superficial draining to, in some cases, the total removal of the soil when its stabilization was impossible. To accelerate the settlement of fills in several cases, vertical sand drainage piles were constructed going down to firm ground, and with full success. These were connected at the top by a system of drainage ditches filled with broken stone, which emptied into a main ditch for the discharge of water pressed from the foundation soil, as the fill progressed. This system was used where the fills crossed flats made up of saturated peaty soils.

In 18½ miles of the highway on the plateau, there are 9.3 miles of fills ranging up to 50 ft in height, and one of 72 ft in height. This is the reason so much care has been taken in their construction. All these fills were placed in layers of 1 ft in maximum thickness. For each type of soil, laboratory tests were conducted, and the fill layers were wet so as to secure the optimum moisture condition for compaction. On the plateau section sheepsfoot rollers were used as compacting equipment; on the Serra section, besides rollers of this type, explosion rammers of 220, 440, 1,100 and 2,200 lb in weight were employed.

These explosion rammers were also extensively used to compact the backfills of bridge abutments. After compaction of each layer, soil samples were taken to determine its density and thereby the degree of compaction obtained. Although the Anchieta Highway was the first field of experiment for artificial compaction of road fills in the State of São Paulo, the results obtained were highly satisfactory.

BRIDGES, TUNNELS, VIADUCTS, AND CULVERTS

On the plateau, besides culverts to drain small streams, there are three important water crossings. These are over two arms of the Rio Grande reservoir, called Rio Grande and Rio Pequeno, and over the canal connecting the reservoirs of Rio Grande and Rio das Pedras. The



PIERS, ABUTMENTS, AND CENTERING IN PLACE FOR CONCRETE CANTILEVER SPANS

Rio Grande and the canal crossings are spanned by bridges, each 280 ft long and composed of cantilever girders.

At the Rio Pequeno arm, the total span is 1,000 ft long and of difficult construction because the water depth reaches as much as 40 ft. The structure employed is a cantilever girder (9 spans of 90 ft and 2 spans of 8 ft), resting upon 30 pre-cast reinforced-concrete cylindrical caissons, sunk by the compressed-air method. Outside diameters are 6 ft in the stem and 8 ft in the working chamber. The bottom of each caisson is belled out at 45° to provide the required area for the allowable soil pressure. The maximum depth was 82 ft below the water level, this being 42 ft below the bottom of the reservoir.

The bridge has two independent decks, one for each strip of 23 ft, and the total width is 56 ft. The piers, however, are bonded, forming a solid block, each supported on three cylindrical caissons.

All intersections with existing roads are arranged so as to avoid grade crossings at any point on the highway. In the Serra region, bridges and viaducts are numerous because of the division of the highway into two roads. There will be 10 viaducts on the ascending road, with a combined length of 2,060 ft, and 10 viaducts on the descending road, totaling 3,670 ft in length. They are hinged structures, designed according to foundation conditions. The variability of the resistance of the rock base, characteristic of the region, lends to the soil different load capacities, which makes it necessary to design the foundations of the structures for their weakest points.

Besides the viaducts, 47 single or double rigid-frame box culverts have been built. The route at the Serra further includes five tunnels lined with reinforced concrete, all of them on curves, with a combined total length of 3,460 ft. One of these tunnels is at an altitude of 1,000 ft, on the ascending road. The remaining four are in groups of two, one tunnel for the highway in each direction, at altitudes of 1,280 and 1,440 ft.

CENTERING FOR AN ARCH OF REINFORCED CONCRETE IN THE "SERRA" SECTION
Flat Coastal Plain Is Visible in the Background

Each concrete strip is 23 ft wide, 6.7 in. thick at the center, and 10.6 in. at the edges, with reduction to the center thickness of 6.7 in. in the next 3 ft. It is built in two lanes each 11.5 ft wide, laid one at a time, separated by a tongue-and-groove construction joint, and joined by $\frac{1}{2}$-in. dowels spaced 2 ft 6 in. apart.

The contraction joints are of the dummy type, obtained by reducing the thickness of the slab by one-third. For this purpose the concrete is cut by inserting a metal strip by vibrating, immediately after compacting. The spacing of these joints is 20, 30, or 40 ft, according to the stability of the embankments and the bearing power of the subbase.

For transferring loads from one slab to the adjoining one through these joints, $\frac{3}{4}$-in. round steel dowels are placed 1 ft apart, at half the height of the slab, each dowel being painted and greased to prevent adhesion. The expansion joints are spaced 120 ft apart. They break the continuity of the concrete throughout with a pine-wood filler $\frac{5}{8}$ in. thick, previously treated against rotting.

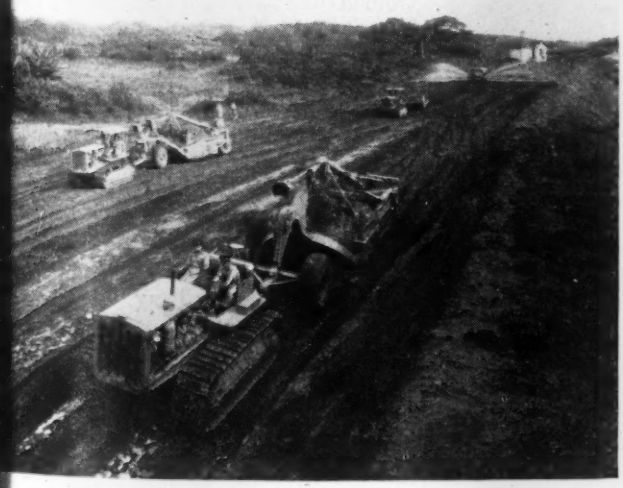
For load transfer through these joints, the same system is adopted as for the contraction joints, except that a metal sleeve is added, placed over one end of each bar to provide free movement of the adjoining slabs. For some stretches of the road, instead of the bars just described, a system of concrete transverse subslabs is being adopted at contraction and expansion joints. These subslabs make it possible to dispense with the dowels and were adopted here, as in Europe and in some North American states, because of the occasional shortage of steel. The slab is built over a previously consolidated subbase, over which is laid first a layer of compacted sand 2 in. thick, and finally a sheet of strong waterproof paper weighing $\frac{2}{5}$ lb per sq yd.

The concrete is mixed at a stationary central plant from which it is hauled and distributed up to a distance of 1 km by dump trucks. Power-operated finishing machines, with surface vibrators, are used.

Finishing of the surface is completed by hand, the edges of the joints being rounded by means of wood floats. The irregularity allowed on the surface is $\frac{1}{8}$ in. every 10 ft; at the edges the maximum difference of level allowed is $\frac{1}{2}$ in. The concrete is cured with wet burlap followed by sand, which is kept on the slab for a period of 12 days.

For the concrete, 5.7 sacks of cement are used per cu yd. Aggregate consists of sand taken from the Tietê River, near São Paulo, and four grades of crushed granite stone. The water-cement ratio is kept at about 0.35 because of the type of compaction adopted (vibration).

Control of the quality of the concrete is made (*a*) by means of compression tests on cast cylindrical specimens, 5.9 by 11.8 in., with vibration, poured simultaneously with the slab; (*b*) by means of cylindrical test specimens cut by drilling the slabs; and (*c*) by means of flexural test specimens 15.7 by 4.7 by 4.7 in. The average rupture stresses obtained at 28 days are respectively 5,700 and 6,430 lb per sq in. (compression stress), and 715 lb per sq in. (flexural tensile stress).



EXTENSIVE GRADING WAS REQUIRED EVEN IN PLATEAU SECTION

Tunneling for Fresh Water on Guam

By JOHN L. WASHBOURNE, LT. (CEC), U.S. NAVAL RESERVE
and NORMAN H. MOORE, LT. (CEC), U.S. NAVAL RESERVE, JUN. AM. SOC. C.E.

OUT in Oceania—where there are 10,000 sq miles of salty ocean for every square mile of land—fresh, potable water will be pumped from the limestone substructure of a coral island. Guam, with its 225 sq miles of rain-catching area, will lend itself to the requirements of the Navy for fresh water. Using collecting tunnels, fresh water will be skimmed from the ground-water supply and pumped to the surface from an underground pump house. Equipment for the job was improvised by Seabee workmen—largely from material left behind by the Japanese.

UNDER the northern plateau of Guam, as under most coral islands, there is a large fresh-water bubble or lens floating on the underlying salt water, with its upper surface arching only a few feet above sea level and its lower surface in contact with the infiltrating ocean water. This bubble extends down from 100 to 200 ft below the level of the sea (see Fig. 1). Tapping this big fresh-water bubble without disturbing its equilibrium, and thus causing salt-water contamination, has posed many interesting questions for the Seabees on Guam.

During the initial water development work, numerous deep drilled wells were sunk throughout the northern plateau area. Each of these wells tapped the underground water bubble at a single point and drew off the fresh water at a rate relatively high in comparison to the bubble area influenced. This resulted in a local drawdown of from 12 to 18 in., with the consequent danger of contamination unless careful control was exercised. As the fresh water floats on the underlying salt water in a delicate balance depending only on the small difference between the densities of the two, any lowering or drawdown of the upper bubble surface results in a rise in elevation of the salt water equal to about 40 times the drawdown, as determined by previous tests. Consequently, if the lens or bubble is thin at the point where it is drawn down by the well intake, the salt water will rise to the well opening, and will ruinously contaminate the well. Accordingly, drawdown on deep wells had to be held down to about 18 in., and this limited output.

To solve the problem it was decided to construct underground tunnels to tap the fresh-water bubble over a far greater area than would be possible with pin-point deep wells. By drilling such underground collection channels along the upper surface of the bubble, it was proposed to skim off the top stratum of fresh water. Further, by spilling this water into a watertight underground sump, and then pumping from the sump rather than from any part of the bubble, it was believed possible to obtain adequate fresh water with virtually no disturbance to the equilibrium of the bubble. Therefore the ground-water station to be here described, which is but one of several to be built, involved the construction of two horizontal collecting tunnels or galleries, each 150 ft long, to skim the upper 2 ft of the water bubble; as well as of an underground pump room and an operator's room. Access to the ground-surface level was to be provided by an entrance tunnel inclined 30°.

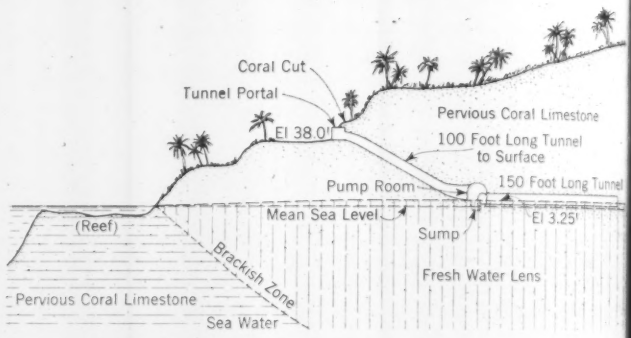
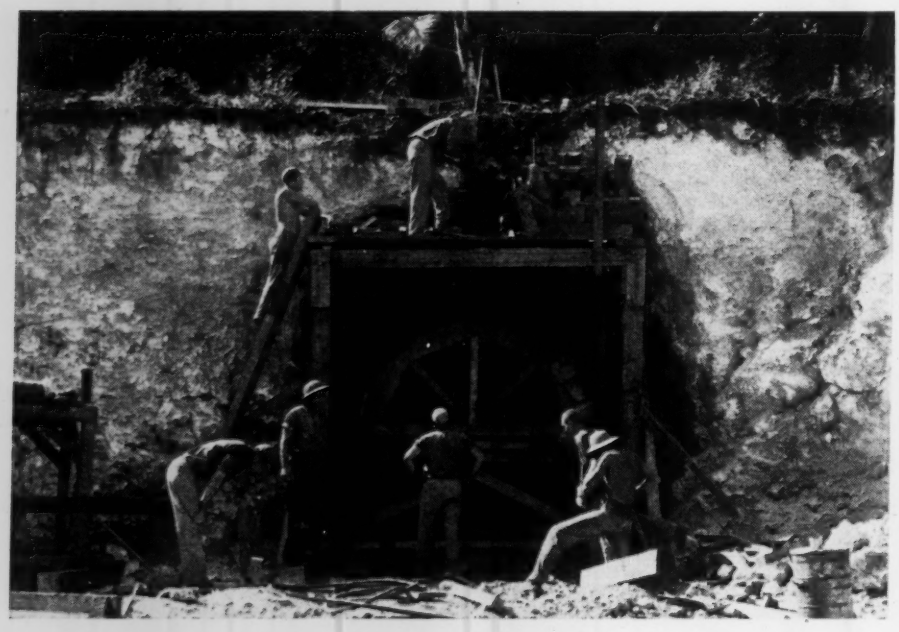


FIG. 1. SKETCH OF WATER-COLLECTION SYSTEM INSTALLED ON GUAM



FORM WORK AT TUNNEL PORTAL, READY FOR POURING OF CONCRETE

Construction of the entrance portal, with a floor elevation at plus 38.0 ft above mean sea level, was started by driving a horizontal bore 12 by 12 ft in cross section a distance of 12 ft into the vertical face of a coral stand. This bore provided space for the pouring of a concrete portal arch 10 ft long with a clearance of 8 ft 6 in. Data obtained from wells in the neighborhood indicated that the top of the water bubble was about 3.0 ft above mean sea level. To descend to this level, the entrance tunnel, after passing through the portal section, was sloped downward at a 30° angle.

Narrow-gage railway dump cars, drawn by a cable and winch, were utilized to remove muck from the excavation. To facilitate the movement of these cars from the 30° slope to the horizontal, the tunnel floor was cut on a vertical curve of 30-ft radius, starting at the end of the 12-ft horizontal portal section. This curved section was paved

with a 10-in. concrete slab, into which rollers were cast to minimize resistance to the change of direction of the car cable.

The entrance tunnel has an overall length of 126 ft, of which the lower 16 ft is on the horizontal. Again a vertical curve of 30-ft radius was utilized at the bottom of the incline for smooth transition to the horizontal section.

The cross section of the inclined length of the entrance tunnel was built in trapezoidal form, 9 ft wide at the bottom, 5 ft wide at the top, and 8 ft 6 in. high. It was timbered with typical trapezoidal mine bents placed 5 ft on centers, and lagged at the roof for the entire tunnel length. The bents were placed successively along the incline by measuring previously calculated vertical and horizontal distances between similar points on each successive timber frame.

The pump room, located at the lower end of the entrance tunnel, has an arch-type roof about 18 ft in diameter. The room is 26 ft long and 18 ft wide, with the springing line of the arch 8 ft above the floor level. Five-piece segmental arches, formed by 12 by 12-in. timbers, placed 6 ft 6 in. on centers, were used to support the roof. Excavation of this large cross-section was accomplished by benching the top 10 ft of the face. This allowed for the placing of the segmental arch before cutting the remainder of the coral cross-section to the same depth.

MUCK CAR AND PUSHMOBILE (A CONVERTED JEEP)
All Wheels and Rails Were Salvaged from Japanese Installations

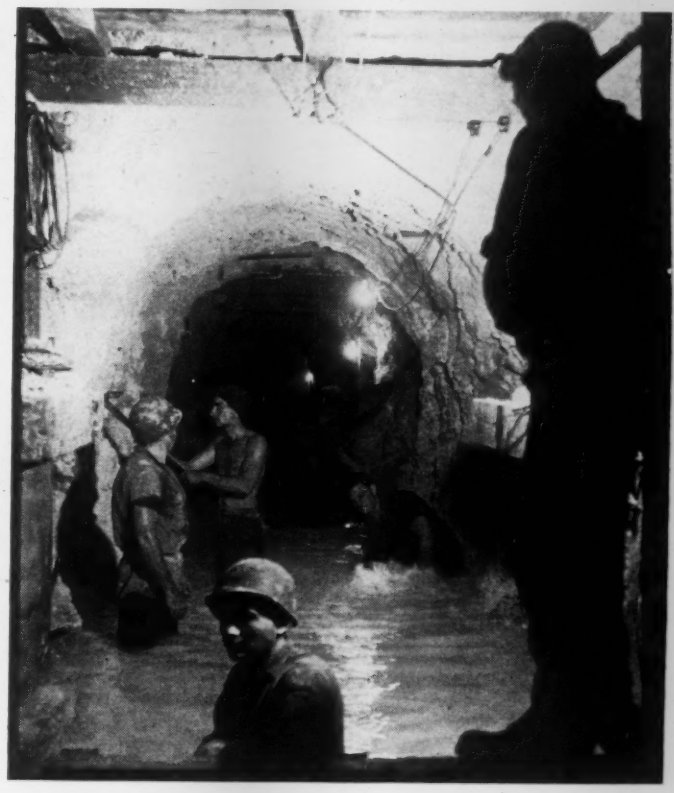
JAPANESE PUSH CARTS AND NARROW-GAGE TRACK, AS FOUND BY THE SEABEES

Construction of the operator's room was similar to that of the pump room. The cross section was different, however, in that the floor elevation was 4 ft higher than that of the pump room. This caused the springing line of the 18-ft-diameter arch roof to be only 4 ft above the floor.

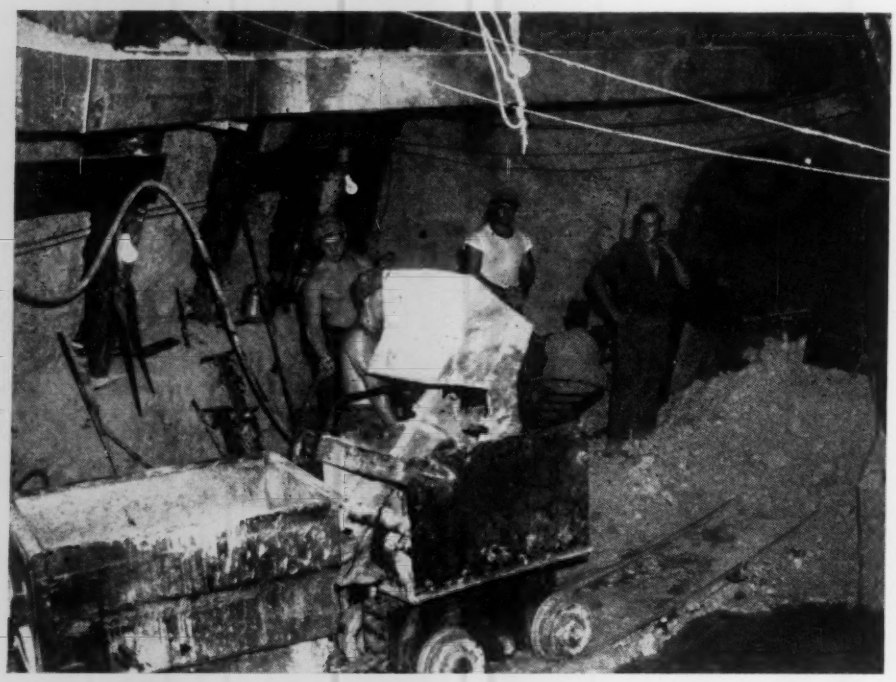
The infiltration galleries consist of two horizontal tunnels both 150 ft long, with a final cross-section 9 ft high and 7 ft wide, with the circular arched roof on a radius of 3 ft 6 in. Tunnel decks are a maximum of 2 ft below the top of the ground-water bubble, so as to form an underground reservoir and channel to the tight sump in the pump-room floor.

Tunnels were constructed in two stages. First, they were mucked out over their entire lengths, keeping the floor elevation just above the top of the water table. The floor level at this stage of construction was at El. +3.5 ft, or about 3 in. above the water, since the top of the water bubble was found at approximately +3.25 ft. As long as excavation stayed several inches above the water, the work could be done in the dry. By carrying the initial tunnel excavation forward at this level, more desirable working conditions were encountered for the removal of most of the muck from these tunnels.

The second stage consisted of mucking out the 2 ft of under-water section in each tunnel. This was accomplished by working from the outboard ends of the tunnels



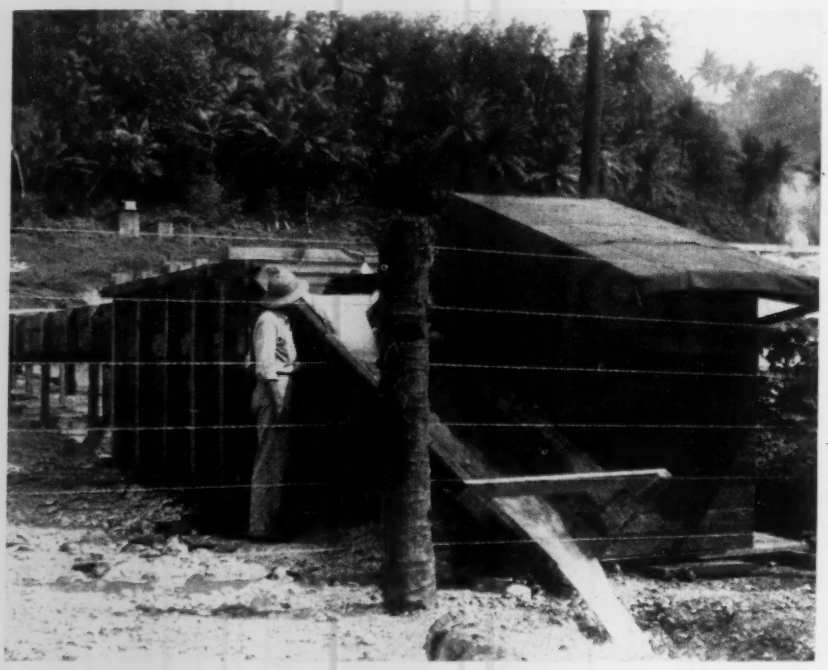
A COLLECTION TUNNEL DURING FINAL TRIM-UP WORK



UNDERGROUND PUMP ROOM WITH SALVAGED AIR-POWERED JAPANESE MUCKER LOADING MUCK CAR
Portal of Perpendicular Collection Tunnel at Right

toward their portals. In this way it was possible to stay in the dry the greater part of the time, as the equipment was backed out of the channel and the track sections were removed as the work progressed back from the tunnel face to the portal.

Coral roof and sides held up so well during the tunnel construction that very little timbering was necessary. Timber bents were used at the portal sections, where ultimately concrete portals 6 ft long were to be poured. The only other timber used was at several sections where the roof had a tendency to overbreak. Bents with overhead lagging were placed at these points.



STILLING FLUME, WEIR BOX, AND NOTCH WEIR USED FOR CHECKING WATER FROM TUNNEL

A tunneling job of this nature called for a special type of equipment which a Seabee Battalion does not normally possess. As a result, much devising and improvising had to be done, using whatever material and equipment were available on the island. The first and most important construction tool found was an air-operated tunnel mucker, left by the Japanese when they were forced, with some reluctance, to hand Guam over to the American forces. In the same way four cars used (after considerable reconstruction) on the narrow-gage tunnel railway system, as well as the track, were involuntarily donated by the Japanese.

Muck from the tunnel was dumped into two tailing piles built up under trestle-work over ground that sloped down from the tunnel portal. To haul the dump cars up the inclined entrance tunnel, an air hoist or winch was set up at the portal. Cars were hauled to and from the tailing piles by a yard engine built from a jeep engine and gears.

The ventilating system first made use of propeller-type blowers, salvaged from a ship. However, these proved inadequate as the tunnel progressed and more air was required. A satisfactory system was finally devised, using a compressed-air turbine-type motor and a centrifugal blower. This delivered about 2,400 cu ft per min into an 18-in.-square sheet-metal duct, which ran down the entrance tunnel to the pump room. The main duct branched off into two pipe ducts of 6-in. diameter, which provided ventilation in each of the collection tunnels.

Two compressors, one of 315, and the other of 500-cu ft capacity, were used to provide power for all air tools and machines. These were connected to operate as a single unit, and were piped to an air receiver of 215-cu ft volume. A 6-in. compressed-air line, to the end of which was attached a manifold, ran from the receiver down the entrance tunnel. At the end of the entrance tunnel, this 6-in. line divided into two 2-in. pipe lines, which conveyed the air for operations in the collection tunnels.

Information as to the approximate yield of the water development was obtained from a volume pumping test on the parallel collection tunnel. This was done by continuous pumping in increments of 100 gal per min, starting at 100 gal per min and progressing through 500 gal per min. A 24-hour period was allotted to each increment.

An old double-action reciprocating steam pump, salvaged from a prewar Navy dredge, was reconditioned and used. During the test, compressed air instead of steam provided the pump's motivating power. The effluent was piped out the entrance tunnel to a weir box containing a 90° sharp-crested weir. To decrease the approach velocity, baffles were placed in the box and an open flume about 40 ft long was constructed on the upstream side. The tests proved that one million gal per min could safely be drawn from the collection tunnels as constructed.

German War Bridge Has Proved Useful to Allied Forces

By JAMES B. COOKE

MAJOR, CORPS OF ENGINEERS, EUROPEAN THEATER OF OPERATIONS, U.S. ARMY

THE "Type-R" bridge was one of about seven standard German railroad war bridges. All had the feature that a variable span and type of structure could be obtained from a minimum number of standard parts. The need for such stock bridges in Germany and the occupied countries was great; they played an important part in maintaining communications and in making possible rail support of the Germans' Eastern front. The "Type-R" is considered in detail because the writer knows more about it, and not because it was necessarily the best and most typical of the German war bridges used.

IT was in Sicily that the Allies first encountered the Germans' long-span war bridges. There the 343d Engineer (GS) Regiment constructed a 98-ft span "Type R-W" bridge. The Type R-W was known as Roth-Waagner and was developed by a firm in Vienna, Austria, for use in the first World War. Roth was the designer, and Waagner the firm. This same bridge was improved in some details and widely used as a standard bridge in this war. The Type R was developed by the Germans as an improvement over the Type-R-W, and the basic details were very similar. When the Type-R was encountered, it was first considered as a Mark II Roth-Waagner bridge because, although the member sections were very different, the principle of making connections and of building up chords was the same.

Interrogation of a German prisoner of war in March 1944 provided early information on the "Type SKR-3" bridge. This prisoner had worked on the erection and launching of a 1,200-ft length of a triple-story bridge, which included a 330-ft span. The bridge was at Zaporzhe over the Dnieper River. The prisoner stated that the development of this bridge was begun by engineering firms under government supervision in 1934. The designation "SKR-3" was derived from Schaper (designer), Krupp (fabricator), Reichbahn (German railways), and 3 (the panel length in meters). This bridge is made up from heavy rolled sections with gussets, and the Type "SKR-6," with a maximum span of 492 ft, is the longest-span standard bridge.

Type-R bridge spans vary in intervals of one meter between 90 and 345 ft longitudinally, and transversely from center to center of bearing, they vary in intervals of several centimeters. The trusses are, according to length of span, of single, double, or triple story. The type of truss is a Warren with hangars for single height, K-type for double height, and S-type for triple height. Through or deck-type construction with a rail or road-deck system is possible for all spans. Further, trapezoidal ends are possible with K-type and S-type deck bridges, and skew ends are possible for all types.

ENGINEERS USE "TYPE-R" ON PRIORITY BRIDGES

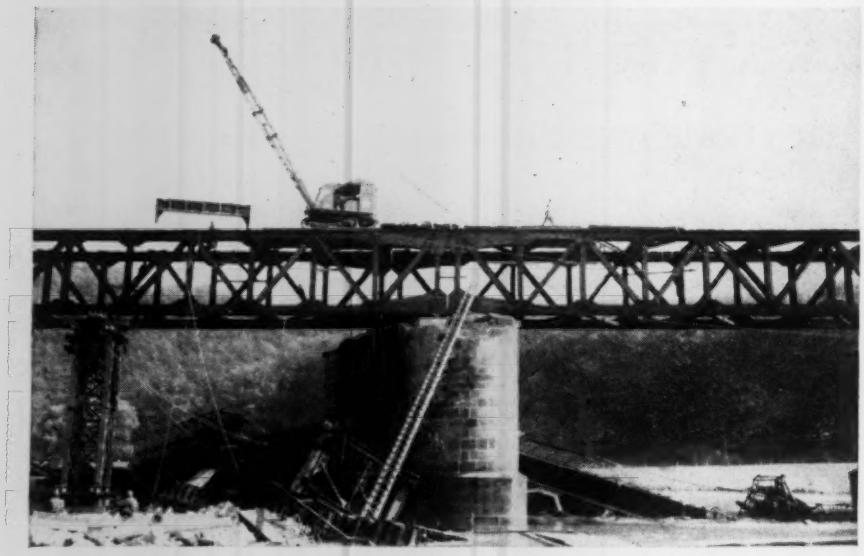
In Germany, both the British and the U.S. Forces captured depot stocks of the Type-R railroad bridge. The Advance Section Communication Zone obtained some drawings and data through the interrogation of German engineer prisoners and a search of German engineer depots. The 332d Engineer (GS) Regiment captured additional plans in a German bridging train at the Elbe River. These data were sufficient to enable us to begin using this very useful bridging material.

At Kassel, Germany, three 100-ft deck spans were erected by the 332d Engineers on old pier foundations that had been recapped. The photographs illustrate this job and provide a picture of the bridging material. Because a captured heavy locomotive crane was available, the trusses were placed by direct lift. The bracing and deck system were placed with a crawler crane which went ahead by picking up sections of timber roadway from behind and setting them forward. This project was urgently prosecuted by the Engineers to open up a direct rail supply line from the Port of Bremen to the U.S. Occupation Zone.

The "semi-tactical" pile-trestle bridges that were constructed over the Rhine were provided with a clear navigation opening of 75 ft horizontal and 22 ft vertical (above a specified mean high water). This was a compromise to permit early movement of barges and tugs, and also rapid construction with the available bridging. Use of the Type-R bridging now makes it possible to conveniently obtain a 150- to 200-ft clear opening, which allows unrestricted navigation.

Three new bridges with Type-R navigation spans will connect the U.S. Occupation Zone with the French Zone across the Rhine River before the winter floods come. One road bridge is nearing completion at Mannheim; accompanying photographs shows the type of sturdy, high-level trestle structure. Piers of the navigation span consist of 30 timber piles enclosed in a sheet-pile cofferdam. The sheet-piling enclosure is filled with

PLACING A PRE-ASSEMBLED TRUSS OF TYPE-R BRIDGE
Derrick in Place to Snub and Set End at Right



FLOOR SYSTEM PLACED BY CRAWLER CRANE
Falsework at Left Was Used During Erection

compacted sand and gravel and capped with 4 ft of concrete. Because complete erection equipment was not available, erection was done by means of falsework.

The Type-R is designed as a railroad bridge for standard German loading, which makes it more than adequate for use as a highway bridge. The design loading for dead load on a single-story bridge is 1.36 short tons per ft. For a double-story bridge, the design dead load is 1.78 short tons per ft, and for a triple story bridge, 2.04 short tons per ft. The live load is the German railway loading *Lastenzug E*, with impact as shown in Fig. 1. The impact factor applied is $1.11 + \frac{56}{L + 46}$ (L in meters). Wind load for the design is 30 lb per sq ft (0.150 ton per sq m) horizontal and perpendicular to the bridge. The braking load assumed is $^1/_7$ of the live load parallel to the bridge and acting on fixed bearing only. This design is for a completely bolted structure. However, when a structure is to be permanent, the bolts are replaced by rivets.

TABLE I. DEFLECTION OF TYPE-R BRIDGE AT MIDSPAN

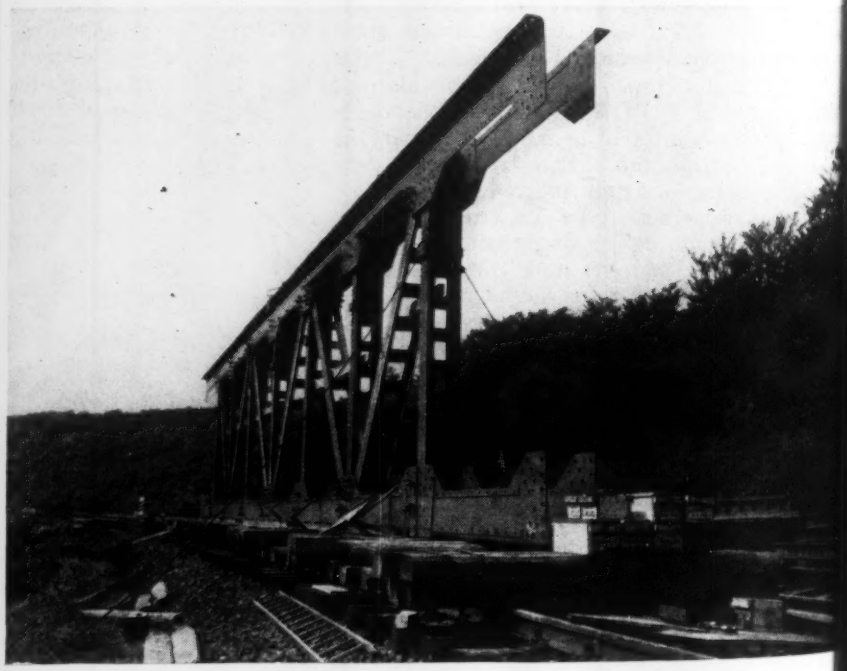
TYPE	MAXIMUM SPAN		DEFLECTION, IN IN.	
	Meters	Feet	Dead Load	Maximum
Single-story	54	177	2.3	6.7
Double-story	84	276	3.1	8.3
Triple-story	105	345	3.9	9.5

Tolerances used in the drilling of bolt holes are not yet known to the writer. The drilling is done with templates and the holes are not reamed. Conversation with the G.I.'s who put the bridges together indicated that the parts can be assembled very easily and require no forcing. Another measure of the close tolerance is the small deflection of maximum spans of the single-, double-, and triple-story bridges (Table I). The steel has a breaking strength of 74,000 lb per sq in. and is the German high elastic steel.

There are only 52 standard pieces, including bolts, that make up the Type-R bridging material. These pieces will make all spans of through or deck bridges for road or rail traffic, and with skew or trapezoidal ends as desired. For a particular bridge, as few as 23 pieces are required. The method of accomplishing this standardization is both simple and ingenious. The main features are explained in the following paragraphs, which are best read with frequent reference to Fig. 2 and the accompanying photographs.

The feature of single-story, double-story, or triple-story trusses gives the wide range of spans. The double- and triple-story bridges are provided with horizontal bracing in the plane of the lower and upper chords. Both upper and lower chords are made up from the same standard parts. A fully reinforced upper-chord section is shown in Fig. 2 (*b*). The basic chord is made up from a chord bar 6 m long (Fig. 2 (*a*)) and from pairs of end chord bars. The normal panel length is 3 m, and there is a special end panel of 2 m. The use of combinations of end panels (3 and 3, 3 and 2, 2 and 2) allows construction of bridges in lengths of multiples of 1 m. A splice plate is shop riveted to the center of the chord bar, and a strip of two chord bars, staggered and bolted together, forms a continuous ribbon of steel. Two such ribbons spaced by the posts and diagonals of the web system form this basic chord. This basic chord is used as a lower chord, but for an upper chord three sets of channel diaphragms, with batten plates, are added in each panel. Two methods of reinforcing are provided: (1) use of an angle stiffener, which increases the compression value of the upper chord; and (2) channel reinforcing, which comes with the splice plate and reinforces either the upper or the lower chord.

The diagonals and verticals of the web members are made of the same pieces in single-, double-, and triple-story trusses. Several different gussets take care of the



TRUSS PARTS BEING ASSEMBLED AND BOLTED AT BRIDGE SITE

various connections. The diagonal is of one type only, but of two lengths, because of the 2-m and 3-m panel lengths. One means of reinforcing is possible. A diagonal reinforcing member of channel section is bolted on each side of the truss diagonal. Spacers are on the member at points where it is bolted to the diagonal, and since the end-connection bolt holes are the same, these bolts are merely put in double shear.

Vertical members are of three types—normal column, light end post, and heavy end post. They are the same type of member except that each is progressively heavier in cross section and provided with additional bolt holes to suit special conditions.

For both deck and through bridges the same floor beams, stringers, and horizontal bracing are used. Transverse portal bracing is used only on double-story and triple-story bridges, and is assembled to suit either the through or the deck type. A bracing member and a gusset plate are the only parts required.

PIERS FOR BRIDGE AT MANNHEIM, GERMANY, WERE ERECTED ON TIMBER PILES

The longitudinal bracing system is of the Warren type and is the same in the plane of the upper and the lower chord. One wind-bracing member and one gusset plate are the component parts. Two types of horizontal gusset are used alternatively in the upper and the lower chord, and serve the purposes of firmly knitting the chord together, seating the floor beam, and connecting the horizontal bracing.

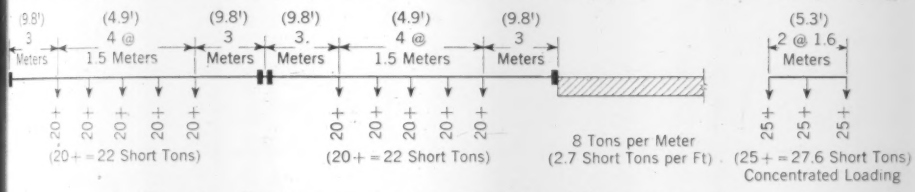


FIG. 1. GERMAN RAILROAD LOADING—"LASTENZUG E"
English Units in Parentheses

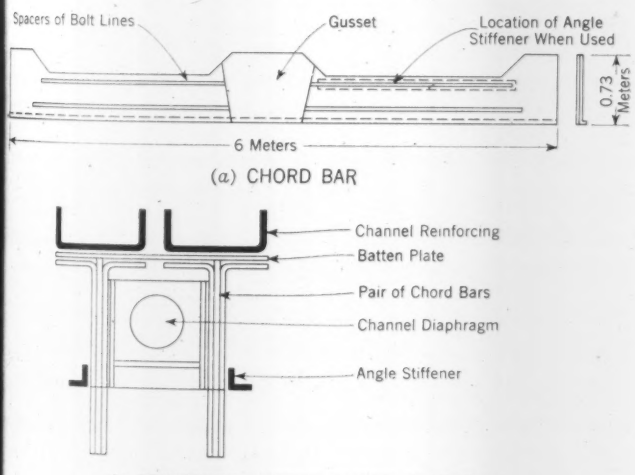


FIG. 2. COMPOSITION OF CHORD MEMBER OF GERMAN TYPE-R RAILROAD BRIDGE

Each bridge has fixed rocker seatings at one end and roller seatings at the other. The end chord members are of heavy section and are provided with many bolt holes in order to allow seating to be at any point. It is therefore possible to vary the distance from center to center of bearing in intervals of several centimeters through the whole range of spans, or in such manner as to provide a variable angle of skew.

Erection of the bridge was considered in detail by the designers, and complete sets of tools and equipment, various methods, and job organization were all prescribed. For this work "building platoons" of 12 men, including one engineer, were recruited from contracting firms. Such a skilled crew, with from 100 to 1,000 prisoners, would erect a multiple-span bridge in several weeks. Foundations were the responsibility of another skilled crew, also supplied with prisoners.

The bill of materials is provided in tabular form for spans varying in length by one meter. The erection diagrams supplied for each bridge are ingenious. The legend gives symbols that cover either deck or through types. These diagrams give the composition of the bridge, and with reference to a few standard drawings for bolt details or framing arrangements, it is possible to erect the structure. Further, when using these diagrams with a bill of materials it would be difficult to make a mistake.

Several methods of erection are possible, and all are fully described in the sets of erection equipment and in the instructions. The various methods are: (1) direct lift of trusses by crane (span determined by available crane capacity), (2) erection on falsework, (3) cantilever erection, (4) launching with or without launching nose.

U.S. Floating Power Plants in Belgium

By S. J. Callahan, M. Am. Soc. C.E.
Lieutenant Colonel, Army of the U.S.; USFET Mission to Belgium

NOW that the war with Japan has ended, an interesting sidelight on the supply of electric energy to assist the advancing armies in the European Theater may be told. The following account has to do with two large United States floating power plants which were placed in Belgian waters while active fighting was in progress on Belgian territory.

Immediately after the liberation of Brussels (September 3, 1944) a survey was made of all uncovered power plants in the country. This revealed that sufficient generating capacity was available to meet the demand of the Allied armies and to supply the necessary energy to the civilian population to maintain order and to prevent unrest. But, after six weeks of experience with the machinery for the production and distribution of coal, the conclusion was reached that assistance should be given to the Belgian electrical industry during the winter because of an anticipated difficulty in supplying the electric plants with sufficient fuel. Accordingly, the Supreme Headquarters Allied Expeditionary Forces (SHAEF) ordered two oil-burning floating plants shipped from the United States. These were originally designed for emergency use on rivers and harbors in the United States, but their possible need in the European Theater had been anticipated, and they were ready for shipment overseas.

Locations for each of the boats were determined, and SHAEF issued the necessary orders for preparations to be made to receive them. One location was alongside the Schelle power plant on the Schelde River near Antwerp, and the other was in the Terneuzen Canal adjacent to the Langerbrugge power plant near Ghent. The plan was to connect the boats to the Belgian grid and operate them as an integral part of the distribution system.

A dual responsibility was involved. The locations selected were in the 21 Army Group (British) area. Therefore, it was the responsibility of the British to design and build the mooring structures and shore connections. On the other hand, the boats were built by the United States and were to be manned by United States crews. Here the responsibility was ours. But no difficulty was experienced. The British Directorate of Works, 21 Army Group, promptly prepared the plans and carried through to completion their part of the work and, when the boats arrived, the Channel Base Section of the U.S. Communication Zone received them, manned them, supplied them, and operated them. The success of this joint venture is just another example of the splendid cooperation which existed between the two great powers.

"Sea Power" in the Terneuzen Canal Alongside the Langerbrugge Power Plant

The boat located at Langerbrugge was known as *Sea Power* and the one located at Schelle, *Resistance*. *Sea Power* was the first to be connected to the grid and started supplying energy to the Belgians at "1730 hours 29 January 1945." But *Resistance* was not far behind. It was moved to its moorings on the fifth of February and was placed on the line at "2230 hours 8 February." Both boats operated continuously throughout the winter and early summer and supplied to the Belgian net 152,645,000 kwhr. At the average rate of coal consumption for all the Belgian thermal plants, this represented a saving of 118,000 metric tons of coal. It cost the Allied Governments approximately 50,560 metric tons of oil. *Sea Power* was disconnected from the net on June 12, 1945, and *Resistance* furnished its last energy on July 29, 1945.

A brief description of these boats may be of interest. They are 358 ft long and have a beam of 50 ft. They are entirely constructed of steel and are so reinforced that the heavy concentrations of machinery are distributed throughout the length of the hull. The shape of the boat, general arrangement of machinery, appointments, etc., are shown in Fig. 1.

Steam is generated by two oil-fired, high-pressure, high-temperature, marine-type boilers, and electric energy is produced by a three-phase, hydrogen-cooled, single-shaft turbo-generator. The salient characteristics of the plant will be described in the following paragraphs.

Steam Generation. The two Babcock and Wilcox boilers, of special marine express type, with a capacity of 170,000 lb per hr each, are designed for a pressure of 900 lb per sq in. at 900 F. Each boiler is oil fired with nine burners—six for the super-heat furnace and three for the saturated furnace. The plant is equipped with two evaporators and one de-aerator. River water is used for makeup.

Electric Generation. There is one G.E., 30,000-kw, 60-cycle, three-phase turbine. It originally operated at 3,600 rpm, but was converted to 25,000 kw, 50 cycles, at 3,000 rpm. This was accomplished by changing turbine blades and altering the governor. The generator voltage is normally 11.5 kv, but by under-exciting it was reduced to 10.5, the voltage of the Belgian machines.

Substation Transformer. This steps up the generator voltage of 11.5 kv to several voltages between 63.1 kv and 138 kv. As will be explained, this was not used.

Frequency Changer. To supply energy for the plant motors, a frequency changer of 1,500 kva was installed.

Other Equipment. This consisted of the following:

Auxiliary generators—two 350-kw diesels, 440-v, 60-cycle
Station transformer—1,500 kva
Boiler feed pumps—175,000 lb per hr, two electric and one steam (Standby)
Fresh-water circulation pumps—four of 500-gal per min capacity
Condensing-water pumps—20,000 gal per hr
Storage tanks in bottom of ship—fuel oil, 485,000 gal; water, 125,000 gal
Commercial refrigeration for 60-day supply
Machine shop, electric shop, and wood-working shop

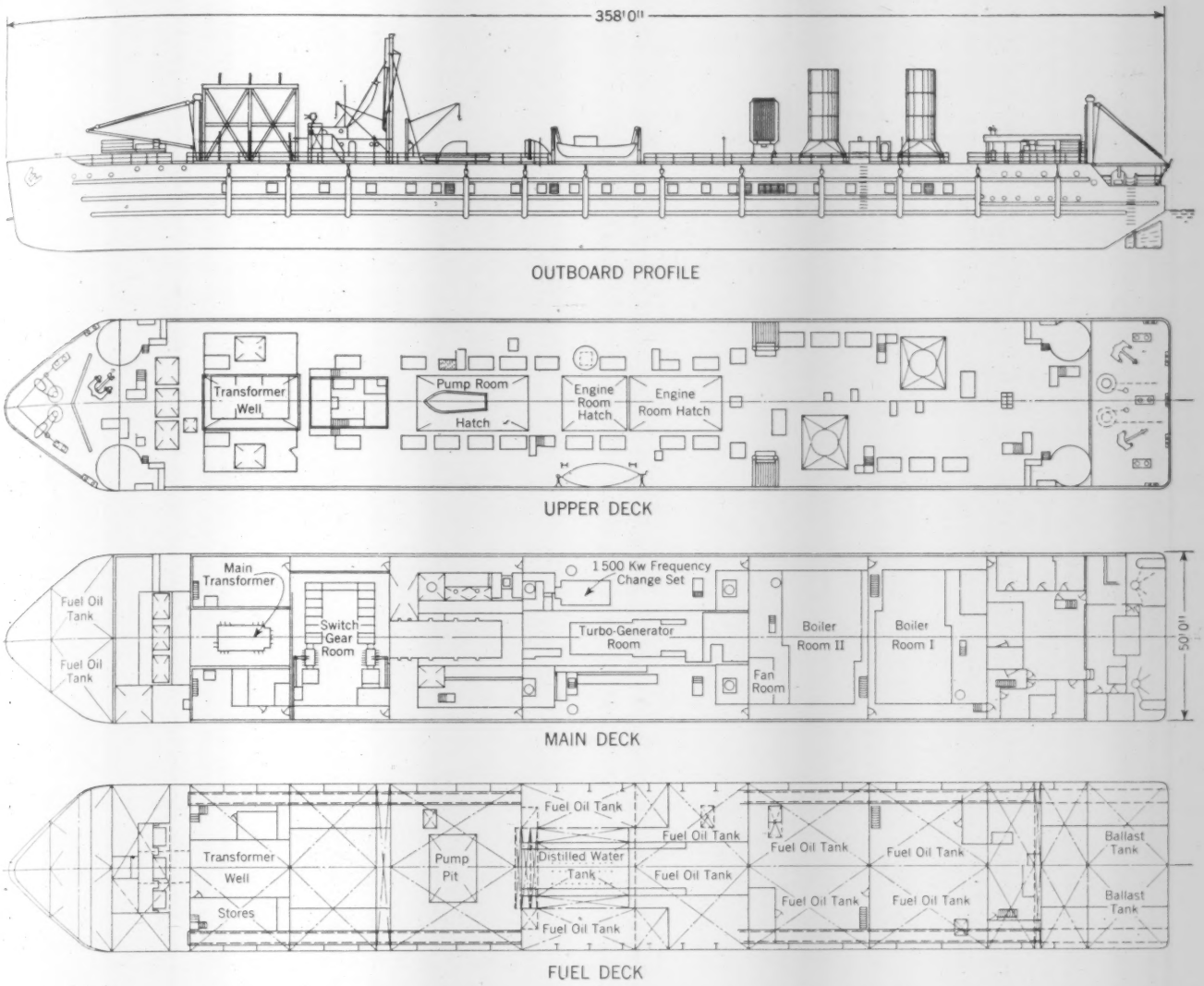


FIG. 1. PLAN AND PROFILE OF U.S. FLOATING POWER PLANTS USED IN BELGIUM

Although the boats are equipped with four large anchors, each weighing four tons, and massive timber struts to hold the boats at a given distance from shore, it was concluded that mooring structures should be built at each location. The position at Schelle, on the river Schelde, presented a problem because of the 17-ft tide. The ebb and flow, especially when there was ice in the river, made it imperative that the structures be substantial. It was finally decided to build two small square docks, one near the bow and the other near the stern, connected to the shore by ramps. Timber piles and timber construction were employed. The top of the docks and ramps was made level with the river dike. This made the dock a few feet above the level of the top deck at mean tide. The boat was made tight against these docks and was held in position against the ebb and flow of the tide by shore lines fastened at several points fore and aft; it was then free to rise and fall with the tide.

The problem at Langerbrugge was simple. There is no tide in the Terneuzen canal and there is no water movement except that caused by passing vessels (Liberty ships and larger). Here dolphin piles were driven fore and aft and a ramp constructed to the stern of the boat.

As has been noted, each of the boats has a transformer capable of supplying several voltages, but none of these happened to be in the close neighborhood of the voltage of the Belgian system (70 kv). Therefore the current was delivered to shore at the generator voltage (10.5 kv) and was there stepped up by spare transformers found in the two Belgian power plants. Bare conductor was used at Langerbrugge but at Schelle it was necessary to use several lines of insulated conductor in parallel. Disconnecting devices were installed on the shore towers.

Fuel oil was delivered by barges of the Royal British Navy, and stores, provisions, and other supplies were delivered by backing up trucks on one of the ramps, to the boat deck. Each boat was furnished with a $2^1/_2$-ton truck and one or more jeeps.

At this point it might be interesting to record that a V-1 flying bomb landed in the Schelde River at the exact spot where the *Resistance* was later moored. And a few days after it was moored a second V-1 hit in the middle of the river immediately opposite the starboard beam. The boat was not damaged except for a few broken portholes on the river side.

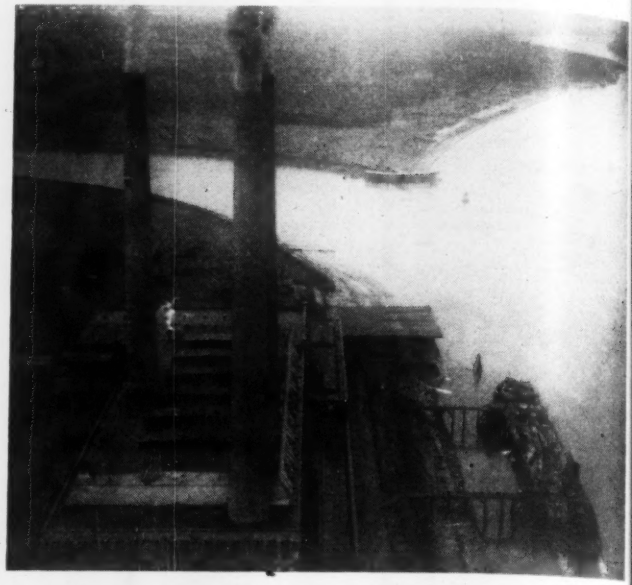
The soundness of SHAEF's decision to place the boats in Belgian waters was substantiated by the subsequent shortage of coal throughout the whole of Belgium. In peacetime the stock of coal for Belgian power plants in the middle of winter usually dropped to 250,000 tons, but on February 1, 1945, it dropped to 28,000 tons. This was just six days' supply at the rate of consumption at that time. A number of large plants were down to a one-day supply on January 24, 1945. The military

authorities were a little nervous about energy for the port of Antwerp, but when the floating power plants were connected their worries were over.

The performance of the boats was excellent. Although rated at 25,000 kw each, they furnished a combined total of over 9,000,000 kwhr per week for several weeks. This was made possible by the action of the Belgians in cutting their plants at night and permitting the floating plants to operate at full load throughout the 24 hours.

Formal receipts have been obtained from the Belgian Government for all the energy delivered. At the time the boats were withdrawn from Belgian waters a price per kilowatthour had not been established, but all quantities were placed in the hands of the respective Offices of Mutual Aid of the United States and Belgian governments. When the War Department establishes the price per kilowatthour, the proper debit and credit can be made.

To satisfy the private companies in Belgium which received and distributed the energy, the Belgian Government established a price per kilowatthour which the companies paid to the Government. This was a negotiated price and represented the average cost of producing energy by the thermal plants under prevailing operating conditions.



THE "RESISTANCE" MOORED TO DOCKS IN THE SCHELDE RIVER. A 17-Ft Tide Necessitated These Special Substantial Structures.

Engineers' Notebook

Suggestions and Practical Data Useful in the Solution of a Variety of Engineering Problems

Torsional Shear in Girders of Skewed Concrete Bridges

By A. L. R. SANDERS, M. AM. SOC. C.E.
HAZELET AND ERDAL, CONSULTING ENGINEERS, CHICAGO, ILL.

HIGH torsional shears may be anticipated in long-span concrete girder-and-slab bridges of large skew angles, because of the restraint imposed by diaphragms at abutments and piers. A method used in approximating the torsional shears and the design of the shear reinforcement for such conditions is here presented.

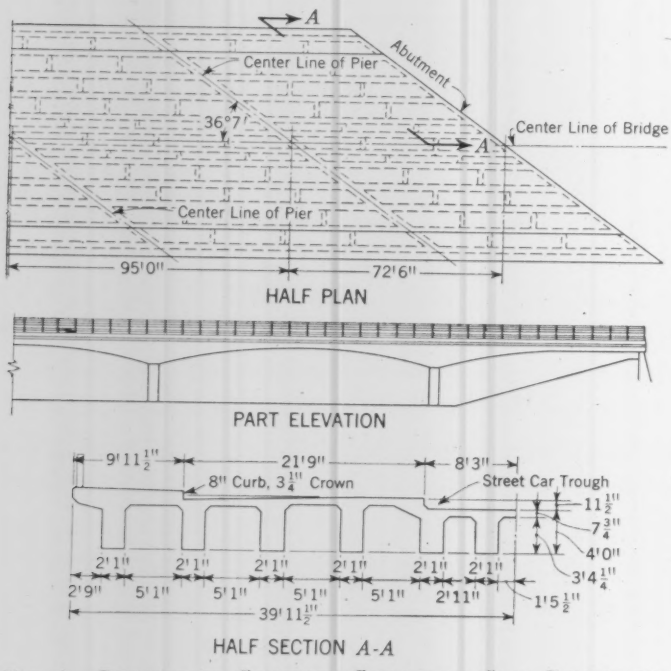


FIG. 1. REINFORCED CONCRETE GIRDER-AND-SLAB BRIDGE ON SKEW CROSSING

The four-span continuous concrete girder-and-slab bridge of Fig. 1 was designed under the writer's direction and is one of many such bridges constructed on the Detroit (Michigan) Industrial Expressway. In connection with the study of girder deflections, it was observed that torsion would take place in the girders because of the restraint of the full-depth diaphragms at the abutment and piers. Advantage was taken of these diaphragms in distributing the girder reactions to the piers and abutments. This avoided the use of steel expansion shoes, a critical material. The omission of diaphragms would have added high bending moments to the floor slabs.

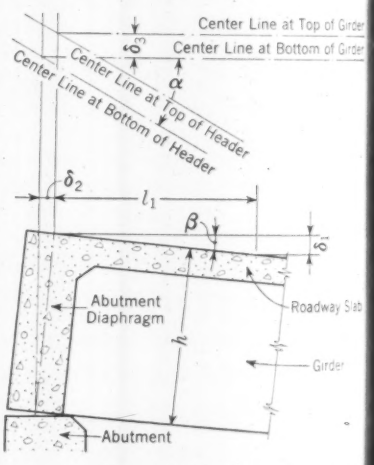


FIG. 2. SECTION THROUGH SLAB AND ABUTMENT AT A TYPICAL GIRDER

The calculated deflections of the street-car girders, made without any attempt to evaluate the distribution of

loads to adjacent highway girders, were found to be much more than those of the highway girders. Before attempting to approximate the torsional deflections, the vertical deflections of the girders were adjusted by reducing the values for the street-car girders and increasing the values of the first adjacent highway girder so that the top of the roadway would have a more or less uniform curvature at transverse sections. From these adjusted deflections it was found that the maximum torsion took place between the abutment diaphragm and the first intermediate diaphragm, a distance of 18 ft in the case of the street-car girders, and 16 ft in the case of the highway girders.

TORSIONAL DEFLECTION AND SHEAR

From the geometry of Fig. 2 it can be seen that the angle of torsion, θ, can be expressed by

$$\theta = \frac{\delta_3}{h} = \frac{\delta_2 \operatorname{cotan} \alpha}{h} = \frac{\delta_1}{l_1} \operatorname{cotan} \alpha. \quad . \quad . \quad . \quad (1)$$

The torque existing in the girder may be expressed by

$$T = \frac{\theta E}{8L} \cdot \frac{b^3 h^3}{b^2 + h^2} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

in which T = the torque in inch-pounds; E, the shearing modulus of elasticity; L, the length of the portion of the girder within which torsion takes place; b, the width of the girder; and h, its depth.

The unit shear at the sides of the girder may be expressed by

$$v_t = T \frac{1.8b + 3h}{b^2\ h^2} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

in which v_t is the shear in lb per sq in. For one of the street-car girders shown in Fig. 1, the torque, T, in the end 18 ft of the girder was found to be 192,000 in.-lb, and the torsional shear, v_t, 302 lb per sq in. The shear, v, in the girder, due to dead load plus live load, amounted to 110 lb per sq in., which gave a combined total, on one side of the girder, of 412 lb per sq in.

Vertical stirrups, at 16,000 lb per sq in., were used for shear reinforcement in the girders throughout their entire length, supplemented by diagonal bars, at 20,000 lb per sq in., in regions of high torsional shear. The concrete was assumed to carry a shear of 90 lb per sq in. In that portion of the street-car girder having a combined shear of 412 lb per sq in. (Fig. 3) vertical stirrups $^5/_8$ in. in diameter, at 6-in. spacing, together with diagonal bars $^3/_4$ in. in diameter, at $9^1/_2$-in. spacing, were used.

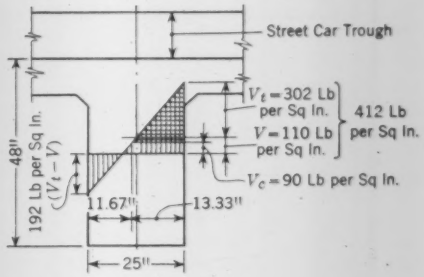


FIG. 3. SECTION THROUGH GIRDER UNDER STREET-CAR TROUGH WITH UNIT SHEAR INDICATED

At the section in question, the total positive shear per lineal inch of girder to be carried by shear reinforcement is equal to the area of the double shaded triangle of Fig. 3, or

$$\frac{(412 - 90)\ 13.33}{2} = 2{,}150 \text{ lb per lin in.} \quad . \quad . \quad . \quad (4)$$

One leg of the $^5/_8$-in.-diameter vertical stirrups may be assumed to carry a shear equal to

$$\frac{0.31 \times 16{,}000}{6} \text{ or } 825 \text{ lb per lin in.} \quad . \quad . \quad . \quad (5)$$

The $^3/_4$-in.-diameter diagonal bars may be assumed to carry a shear equal to

$$\frac{0.44 \times 20{,}000}{9.5 \times 0.707} \text{ or } 1{,}325 \text{ lb per lin in} \quad . \quad . \quad . \quad (6)$$

Our Readers Say—

In Comment on Papers, Society Affairs, and Related Professional Interests

Comments on Floating Power Plant

TO THE EDITOR: On page 341 of the July issue there is an "Item of Interest" on the development of the floating power plant by the Corps of Engineers. Years ago a battleship simply furnished power from her own large capacity to one of the cities on the West Coast.

The first vessel actually built over entirely for the purpose of serving power was the power ship *Jacona* of 20,000-kw capacity, which furnished power at Bucksport, Me., in 1930, and later at Portsmouth, N.H. During the war it was taken over by the Army.

FRANK H. MASON, M. Am. Soc. C.E.
Chief Engineer, New England
Augusta, Me. *Public Service Company*

A "New" Structural Shape for Shipbuilding

TO THE EDITOR: I was interested in Mr. Fitzgerald's article, entitled "A New Structural Shape for Shipbuilding," in the September issue.

The "new" section proposed by Mr. Fitzgerald (Fig. 4, page 410) should be compared with the bulb beams rolled in iron and steel over fifty years ago, at which time Pencoyd was producing seven different sections of substantially the same range as suggested.

New York, N.Y. JULIAN H. GRANBERY, M. Am. Soc. C.E.

Forum on Professional Relations

CONDUCTED COLUMN OF HYPOTHETICAL QUESTIONS WITH ANSWERS BY DR. MEAD

In the current issue Dr. Mead gives his answer to Question No. 36, which was announced in the September issue. The question reads as follows: "If an inspector on a job saved a contractor considerable money by showing him an easier method or short cut in doing some work, would the inspector be justified in receiving remuneration in money or otherwise from the contractor?"

The writer has always felt that it was his personal duty when in charge of work to assist the contractor in every legitimate way that he could. Thus, in his opinion, it would be entirely unethical for the inspector to accept compensation for simply doing what the writer considers his duty.

With the December issue of CIVIL ENGINEERING, the writer will have conducted this column for three years. While a number of persons have expressed their interest in the column to him, he has decided to discontinue it with his answer to Question No. 37, which will be given in the December issue. Instead, from time to time, the writer will offer a discussion of some of his own experiences in the field, the first to appear in the January issue. The writer hopes that this new form of discussion may arouse interest and lead to the expression of the experiences of others in similar matters.

DANIEL W. MEAD, Past-President
Madison, Wis. and Hon. M. Am. Soc. C.E.

SOCIETY AFFAIRS

Official and Semi-Official

Collective Bargaining and TAPEE

Abstract of a Report by Elisha Hanson, Attorney and the Society's Labor Consultant

THE ANNOUNCEMENT by President Truman of the development of the atomic bomb at the Clinton Engineering Works, Oakridge, Tenn., and the use of this bomb in the last few days of the war against Japan, make it possible for this Society to report to its membership on a long-drawn-out labor controversy that threatened for a time to interrupt the production of the bomb at the most critical stage of production.

When the atomic bomb project was initiated, the plans called for the construction of a great plant at Oakridge, Tenn., some miles outside of Knoxville. Hundreds of engineers and thousands of workmen were required on the job. Contracts were let to Stone and Webster and other contractors for the construction of the plant. Some time after construction got under way, efforts were made by the International Federation of Technical Engineers, Architects and Draftsmen's Unions to organize all the employees on the project drawing up to $100 per week, including professional engineers. This long-named union is part of the A. F. of L.

Members of the American Society of Civil Engineers who were affected conferred with a member of the staff and organized the Tennessee Association of Professional Engineering Employees, hereinafter referred to as TAPEE. TAPEE confined its membership exclusively to professional employees professionally employed in the Tennessee Valley area, including Clinton Engineering Works.

Immediately after the organization of TAPEE, the A. F. of L. union sought to obtain consent from Stone and Webster for an election to determine the question of its right to represent all employees in the plant in bargaining. TAPEE countered this with a request that the employees be divided into professional and non-professional groups and that an election be held for each group so that those professionally employed might express their wishes in a group composed exclusively of professionals on the question of representation for bargaining.

These requests were referred to the National Labor Relations Board's Regional Office at Atlanta. After conferences, the National Labor Relations Board eventually refused to take jurisdiction in the case. The A. F. of L. union then appealed to the War Labor Board, which at first refused to take jurisdiction on the ground that one of the chief questions involved was the right of representation and it had no authority to pass upon that question.

After both the National Labor Relations Board and the National War Labor Board refused to take jurisdiction over its appeals, the Technical Engineers Association took steps to have a strike vote held under the terms of the Smith-Connally Act. The sole basis of the request for a strike vote was to obtain representation of all employees, professional as well as non-professional, working on the project.

Letters were then dispatched by the attorney for TAPEE to the Secretary of Labor, the National Labor Relations Board, and the National War Labor Board, with a copy thereof to the Secretary of War, in which were set out the details of the controversy between the parties and an argument that the Technical Engineers Association had no legal right to obtain a strike vote under the Smith-Connally Act.

There followed an argument by paid advertisements in local newspapers by both sides to the controversy. Then a representative of the National Labor Relations Board went to Knoxville to try to effect a settlement between the Technical Engineers Association and TAPEE. A conference was called by this representative and was attended by representatives of TAPEE, the Technical Engineers Association, and the U.S. Army Engineers. No agreement was reached.

Following the failure of this conference, the New Case Committee of the National War Labor Board recommended that the Board take jurisdiction of the case under the War Labor Disputes Act and instruct the Regional Director at Atlanta to hold a hearing on the questions of working conditions and wages only.

In spite of TAPEE protests, a strike vote was officially authorized for May 3, 1944. There were more advertisement-arguments in the local newspapers. TAPEE urged all employees to vote "no," pointing out the importance of the war project and asserting that a strike at that time would be akin to treason. The A. F. of L. union, following the publication of the advertisements by TAPEE, called off the strike vote.

The War Labor Board held a hearing at Knoxville on May 8 and 9, 1944. It allowed TAPEE to appear through counsel as an amicus curiae but not as a party of interest. On May 25 the War Labor Board Panel made a recommendation that the Fourth Regional War Labor Board assume jurisdiction of the representation question and decide it. This recommendation is in direct defiance of the law, which gives sole jurisdiction of representation questions to the National Labor Relations Board, not to the War Labor Board.

Following this recommendation of the Panel, a situation developed which required TAPEE formally to have a dispute with Stone and Webster in order to protect the rights of its members. On the advice of counsel, TAPEE addressed a letter to Stone and Webster requesting a conference for the purpose of negotiating a contract to represent the professional engineering employees employed by that concern. This request was refused by Stone and Webster because of the recommendation of the War Labor Board Panel. TAPEE then wired the Director of the U.S. Conciliation Service to send a Conciliator to settle the dispute between TAPEE and Stone and Webster. The Conciliation Service refused to send a Conciliator and stated as the basis of its refusal that it had been advised by the Atlanta Regional Office of the War Labor Board that it expected to act upon the case promptly and that no Conciliator should be assigned to consider a dispute by any party other than the Technical Engineers Association. This information was conveyed to Mr. Hanson in Washington, who immediately forced the Conciliation Service to reverse its stand and to send a Conciliator to Knoxville in an attempt to adjust the issues in dispute.

The Conciliator arrived in Knoxville on June 19. On the following day the Regional War Labor Board made public its recommendations as follows:

1. That question of appropriate bargaining unit be submitted to an arbitrator for a final and binding decision.
2. That a collective bargaining election be conducted by the Army Engineers to determine the collective bargaining representative in the unit found appropriate by the arbitrator.
3. That the company and the employee organization selected by this vote negotiate for a period of 30 days on a collective bargaining agreement.
4. That the Board assign this case to a panel to determine the wages, hours, and working conditions of the employees involved if the parties to the case do not agree to the preceding recommendations.

On the advice of counsel, TAPEE refused to submit the question of an appropriate bargaining unit to any arbitrator. TAPEE maintained the position that there should be two bargaining units, one for professionals professionally employed and the other for non-professionals.

Even though TAPEE had been refused the right to intervene as a party to the proceeding before the War Labor Board, nevertheless the War Labor Board treated it as a party in attempting to force it to comply with the WLB Panel recommendations. In order to bring the War Labor Board into a proper perspective, TAPEE filed a petition to intervene in the case and to review the order recommending arbitration of the appropriate bargaining unit. Local counsel for TAPEE was promptly advised by a representative of the War Labor Board that the Board would ignore the petition but that TAPEE should accept the arbitration procedure. This representative was referred to the Washington, D.C., counsel for TAPEE, who informed the representative of the Atlanta Regional War Labor Board Office that under no condition would TAPEE

agree to enter into an arbitration until and unless the National War Labor Board recognized it as a party of interest in the proceeding.

To the accusation by the WLB representative that the attorney for TAPEE had taken an arbitrary and unwarranted stand, it was pointed out that if TAPEE was not recognized as a party of interest, TAPEE was not in a position to be party to the proposed arbitration. The TAPEE attorney also called to the attention of the WLB representative that the record indicated some very odd contortions by the WLB. The record shows that the War Labor Board first rejected the claim of the Technical Engineers Association on the ground that it had no power to pass upon the representation issue; that later when the A. F. of L. union forced the issue by threatening to call a strike, the War Labor Board capitulated to that union on a vital issue of procedure; that when TAPEE tried to intervene in the case as a party of interest as was its right, the Board denied its intervention; that after the hearing in Knoxville, the War Labor Board Panel found that the controversy could not be settled until the representation issue over which the War Labor Board admitted it had no jurisdiction was first settled, and that when the Panel's recommendation was acted upon by the Regional Board and a copy of the recommendation was sent to TAPEE, the latter again took the proper steps to intervene after being advised that the Regional Board considered it a necessary party to the arbitration recommended for settlement. TAPEE's attorney flatly stated that until and unless the National War Labor Board recognized the rights of TAPEE and its members, TAPEE would not be sucked into any procedure that would defeat the efforts of the professional employees on the project to protect their rights.

Subsequent to this unofficial argument between the WLB and TAPEE attorneys, a further hearing was held by the National War Labor Board. The representation issue was avoided. The Board took up the claims of the Technical Engineers Association and of TAPEE. It issued a directive order which in effect adversely affected professional employees employed by Stone and Webster in that under the Board's directive the professional employees would have had to readjust their working conditions and their salary scales to bases inferior to those in effect at the start of the controversy. TAPEE immediately petitioned for a reconsideration of this order on the ground that it not only violated Board policy but violated the law. The National War Labor Board granted the petition for reconsideration, reconsidered the case, reversed itself, and approved the working arrangements in effect at the time the hearing was held. No appeal was taken from this.

There the controversy ended. Professional employees employed on the project were not forced into the heterogeneous union. TAPEE preserved the rights of its members to remain free of such domination and control. TAPEE forced the calling off of the strike vote which, if taken, undoubtedly would have authorized a strike and delayed the production of the atomic bomb for days, possibly weeks or months. In no part of the proceedings, however, was TAPEE officially recognized by the WLB or NLRB as an appropriate bargaining group or unit.

In so far as the representation issue is concerned, it must be borne in mind that the National Labor Relations Board has sole jurisdiction over that question; and that that Board has laid down the policy that professional employees shall not be included in a heterogeneous unit where they petition the Board to designate a unit composed exclusively of professional employees employed in their profession and to direct an election by the persons in such a unit to determine their wishes as to bargaining representatives.

As a matter of procedure, it must also be borne in mind that the minute a heterogeneous union seeks to corral professionals, the professionals must act for their own protection. The ending of the war with Japan probably means the passing out of the War Labor Board procedures in part or in whole in the near future. However, as long as they exist, the experience in this case shows that professional employees, in order to obtain any standing before that Board in a dispute such as existed in Tennessee must, first, make demands upon the employer, second, in the event of the employer's refusal to grant those demands, make request for the services of the U.S. Conciliation Service, and third, if conciliation fails, request the National War Labor Board to settle the dispute. The dispute can be concerned however, only with wages, hours, and working conditions. It cannot legally concern itself with the question of representation. That issue can be decided only by the National Labor Relations Board.

Meeting of Board of Direction—Secretary's Abstract

THE BOARD met on Monday and Tuesday, October 15 and 16, 1945, at the Palmer House, Chicago, Ill., with President J. C. Stevens in the chair and William N. Carey, Secretary; and present also Past-Presidents Pirnie and Whitman; Vice-Presidents R. E. Dougherty, Howard, Polk, and Thomas; and Directors Breed, Bryan, Critchlow, N. W. Dougherty, Edwards, Gamble, Gardner, Goodrich, Hathaway, Koch, Saville, Scobey, Shannon, Thomson, Tipton, Tolles, and Wilson; also Treasurer Trout. W. W. Horner, official nominee for President for 1946, was also present by invitation.

Preceding the Board meetings, various committees held extended sessions preparing material for Board consideration. In addition to such sessions on Saturday and Sunday, both morning and afternoon, breakfast and other committee meetings were called on succeeding days.

Executive Committee

The Executive Committee met both Saturday and Sunday. Its actions were later referred to the Board for decision or confirmed by the Board. Such procedures are herein reported as actions of the Board.

Minutes

Meeting records of the Executive Committee for July 15 and of the Board for July 16 and 17, all at Detroit, were approved as submitted in written form.

Dues

Regular procedure for the coming year was confirmed with regard to amounts payable to the Society as dues from members in foreign countries having adverse exchange rates. Authorization was given extending to the coming year cancellation of dues requested by members in the armed services whose base pay does not exceed $2,400 per annum; with the proviso that such provision automatically expires as of thirty days following discharge. Other special matters affecting dues were also considered.

Future Society Meetings

Signalizing the return of peacetime conditions, it was voted to resume the practice of having Society quarterly meetings beginning and continuing throughout 1946.

Outstanding Student Chapters

Following recommendation of its Committee on Student Chapters, the Board confirmed the award of letters of commendation by the President to fifteen Student Chapters.

Public Relations

A new department in the Headquarters Staff was authorized in the form of an Assistant to the Secretary, to have special duties in regard to public relations.

Authorized Abbreviation—Society Name

The official term for abbreviating the Society name was changed to the form "A S C E" (narrow space but no period between letters), superseding the former style "Am. Soc. C.E."

Change of Fiscal Year

By previous action of the Board, the fiscal year was changed to the period October 1 to September 30, instead of January 1 to December 31.

Memorials to Members

Reports were received and approved covering recent inspections of the J. Waldo Smith and Merritt H. Smith Memorials, at Brown Station, N.Y., and Kensico Dam, Valhalla, N.Y., respectively. Responsibility for these memorials is vested in the Society, and provided for by appropriate funds.

New Members of Division Executive Committees

Acting on recommendations of the executive committees of the Divisions, the Board appointed new members to the executive committees of the Divisions, in each case for a term of 5 years. In the case of the City Planning Division, a second appointee was named to take the place and fill the term of the late P. L. Brockway. The new committee members are:

City Planning	Frank H. Malley
	Lawrence V. Sheridan (4 years)
Construction	E. P. Palmer
Engineering Economics	George H. Burgess
Highway	John W. Wheeler
Hydraulics	Julian Hinds
Irrigation	George D. Clyde
Power	Albion Davis
Sanitary Engineering	Raymond F. Goudey
Soil Mechanics and Foundations	James H. Stratton
Structural	Craig P. Hazelet
Surveying and Mapping	George D. Whitmore
Waterways	Charles B. Burdick

Collective Bargaining

Long consideration was given to the form of pending Government legislation relative to labor problems as affecting professional engineers. As a matter of Board policy the following practice was affirmed: To give to Society members, when requested, all practicable assistance in collective bargaining problems, within legal, financial and staff limitations.

Staff Reports

Activities of the Washington and Pacific Coast offices were covered by quarterly reports. These were received, with appropriate actions as required.

Representative on Pacific Coast

It was announced that Henry L. Thackwell had resigned as Society Field Representative and head of the Pacific Coast office. In his place, Maj. Walter E. Jessup is appointed, resuming his connection with the Society which began in 1930 and was interrupted by the war. A separate item deals with this matter.

Postwar Construction

Report was received from G. Donald Kennedy, chairman of the Society's committee on this subject, recommending that the committee itself be discharged but that the program under way be prosecuted to an effective conclusion. The Board so voted, with grateful appreciation for all the accomplishments of the committee.

New Air Transport Division

Concurring with recommendations of the Committee on Division Activities, the Board authorized the organization of a new Division concerned with air transport, but decided that activation of the Division should await results of a survey or appraisal of all Division programs.

Ethical Practice

The Committee on Professional Conduct reported on three cases of alleged questionable activities.

Publications

The Committee on Publications recommended enlargement of this Society work. The Board agreed in part, authorizing that professional cards be included in CIVIL ENGINEERING and approving the character of this advertising.

New Montana Section

The Committees on Local Sections and on Districts and Zones concurred in approving request of Montana members that the state be made a separate Local Section attached to District 12. Preliminary steps were taken to effectuate this change. Further suggestions re allotment of funds to Local Sections, and resumption of the geographical list in the Year Book were approved.

Registration and Model Law

The Board approved of new definition of "professional engineer" and "practice of engineering," as proposed by a general conference on August 28 covering this matter. The wording is given in detail in a separate item.

Private Engineering Practice

The committee charged with this matter reported. The Board recorded its official opinion that engineering work on airports not under the Armed Services should be decentralized and handled in the local communities concerned.

Planning Research

An iterim Committee on Research to make recommendations to the Board was authorized. Its scope is to include study of government as well as Society activities. The following members were appointed by the President: Thorndike Saville, chairman; R. E. Dougherty, W. M. Wilson, B. A. Bakhmeteff, J. D. Justin, A. Wolman, and W. N. Carey, ex officio.

Simplifying Membership Transfer

Following constitutional procedure, vote was taken amending the Society By-Laws, Article I—Sections 1, 2, and 3, to facilitate transfer from Associate Member to Member grade. These amendments are given in complete form in the Society Affairs pages.

New Title—"Secretary and Executive Officer"

As more in keeping with his functions in charge of Society activities, the title of the Secretary was changed to "Secretary and Executive Officer."

Study of Economic Status of the Engineer

Progress of the survey by a joint committee of the Engineers Joint Council on the Economic Status of the Engineer was reported. Suggestions of the Council were adopted appropriating money for the Society's share and inviting the National Society of Professional Engineers to join in this committee work.

Engineers Joint Council

The Board approved action of the Engineers Joint Council inviting the National Society of Professional Engineers to become a constituent member of the Council. It also provided an alternate for Society representative on the Council.

The Board agreed to the proposal of the Engineers Joint Council in appointing a committee to consider pending federal legislation regarding the promotion of research, in engineering as well as science; and approved the appointment of a Society representative with instructions to follow this matter actively.

Activities of the Joint Council under Past-President Pirnie, including the extensive work in formulating and effectuating its significant report, "Industrial Disarmament of Aggressor States (Germany)," were detailed. This information was received with special commendation to Mr. Pirnie. The report itself, omitting tabular data, is given elsewhere in the Society Affairs Section.

Other Activities

Various committees, such as that on Membership, reported their activities in detail. Some of these reports were for information only and others were subject to appropriate action.

Appreciation for Hospitality

Cordial appreciation was extended to the Illinois Section for all its courtesies and entertainment in connection with the Board meetings.

Universal Military Training

Two resolutions were adopted dealing with the subject of universal military training. Of these, one was originally presented at the Detroit Meeting of the Board and adopted at the present meeting with some revision. The second emanated from the September 25 meeting of the Engineers Joint Council.

Budget Adopted

Conforming to the new fiscal year, which starts October 1, the Executive Committee submitted its budget for Society receipts and expenditures. After full discussion this was adopted as recommended.

Adjournment

The Board adjourned at 5 p.m., October 16, to meet on Monday, January 14, 1946, at Society Headquarters.

Seabury Memorial Established by Oklahoma Section

A YEARLY PRIZE for the best paper written by a Junior of the Oklahoma Section has been provided by that Section, to be known as the George T. Seabury Memorial Award. No limitations have been placed on the subject of the paper, and the amount of the award will be set each year by the Board of Directors of the Section.

After some study the Memorial Committee, headed by J. E. Lothers, recommended this type of memorial because of the stimulation it would provide to younger members for professional development. It was recalled that one of the late Secretary's prime interests was such growth of young engineers in the profession.

Judges of the award will be the Board of Directors of the Oklahoma Section. To be eligible, a paper must be presented orally before a regular meeting of the Section. Action in establishing the award was taken at the meeting of September 8 in Tulsa.

By-Laws Amended re Membership Transfer

THE BOARD at its Chicago meeting completed the necessary formalities to effectuate a change in the By-Laws, Article I—Sections 1, 2, and 3, designed to facilitate transfer from the Associate Member to the Member grade. In due course these changes had been officially proposed to the Board and were thus eligible for adoption at the Board meeting. Details of the amendment as adopted are here given, all referring to Article I of the By-Laws.

An additional paragraph is to be included in Section 1, by inserting the following after the third paragraph of that section:

"An applicant for transfer from Associate Member to Member may use a short form of application, approved by the Board of Direction, on which shall be presented his professional experience from the date of his admission as Associate Member, except that all prior experience, which he considers to be Member grade, shall be included. The applicant shall furnish the names of at least three references who shall have personal knowledge of the applicant and his experience, two of whom must be Corporate Members. No application for transfer from Associate Member grade, except as hereinafter provided, shall be considered by the Board until at least three such references have made definite recommendations based upon personal knowledge."

An addition is also made in Section 2 with relation to subparagraph (*c*), which has been expanded to read:

"(c) Each employer or associate to whom the applicant refers for verification of applicant's professional record, except that verification shall be made only when requested by the Committee on Membership Qualifications in cases of transfer from Associate Member to Member."

Likewise sub-paragraph (*d*) of the same Section, has been changed, to read as follows:

"(d) Each college or university which the applicant attended for verification of his scholastic record, except that such verification shall not be required in cases of transfer; and"

Finally an addition was made at the end of Section 3, referring to interviews and recommendations by local membership committees. The new Section continues to provide for such procedure but adds:

"except that personal interview shall not be required in cases of transfer from Associate Member to Member unless specifically requested by the Committee on Membership Qualifications."

It will be noted that the new details of transfer make the procedure considerably easier for the Member, but without sacrifice of any important detail required for judging the engineering experience in question. Thus the change should be satisfactory from the standpoint of administration by Society committees, and even more important, it should be of convenience to the Members concerned and facilitate and stimulate transfers to the higher grade.

Radio Quiz Contest Held by Buffalo and Rochester Sections

AN INTER-CITY contest between the Local Sections in Buffalo and Rochester was held via radio on October 14. The quiz program, while arranged by the Sections, was sponsored by the Lambert Pharmacal Company as one in their series of "Quiz of Two Cities" programs. The program was broadcast from Station WHAM in Rochester and WBEN in Buffalo.

Contestants from the two cities appeared in their local stations for the quiz. Identical questions were asked at each station, but no contestant heard the answer of his rival. By special hookup, the broadcasts from the two cities were timed and blended so that listeners were in on both sides of the contest. Contestants not only enjoyed the contest but received monetary prizes. The winnings were contributed to a War Memorial Fund and to the Local Section treasuries.

Arrangements for the contest were made by Frank Kulas of the Rochester Section. His team mates were Harry Eustance, Carl Cooman, and A. B. Squire. The Buffalo team consisted of A. S. Collins, George Minniss, Nelson Stone, and H. C. Woods. On the basis of the points and cash won, the Rochester team was declared the winner.

Construction Industry Advisory Council

THE CHAMBER OF Commerce of the United States, after several months of careful study of problems facing the construction industry in the critical period ahead, has recommended the setting up of a Construction Industry Advisory Council. The purposes and scope of this Council are threefold:

1. To help develop construction industry opinion.
2. To make recommendations to the Construction and Civic Development Department Committee of the National Chamber for carrying out policies or programs of common interest to the construction industry.
3. To provide the Department Committee with more clearly defined and better organized contacts than now exist with trade and professional associations in the construction field.

President Stevens of the Society was urged to accept the chairmanship of this newly formed Council. He has accepted. Its first meeting is scheduled for November 1, 1945, at Washington, D.C.

Defining Engineer and Engineering

NEW FORMS for the definitions of "Professional Engineer" and "Practice of Engineering" have been formulated and are in the process of being presented for approval to the various engineering organizations for comment and approval. The proposal originated in a conference held on August 28, 1945, at Society Headquarters. This meeting covered the subject of the Model Law for the Registration of Professional Engineers and Land Surveyors. It was widely attended—by representatives from all the national organizations closely affected.

The principal items to come out of this conference were the new definitions. Following discussion at the conference, it was recommended that the definitions be approved by the several organizations represented, in the following form:

"Definition—Professional Engineer:

"The term professional engineer within the meaning and intent of this Act shall mean a person who, by reason of his special knowledge of the mathematical and physical sciences and the principles and methods of engineering analysis and design, acquired by professional education and practical experience, is qualified to practice engineering as hereinafter defined, as attested by his legal registration as a professional engineer.

"Definition—Practice of Engineering:

"The term practice of engineering within the meaning and intent of this Act shall mean any professional service or creative work requiring engineering education, training, and experience and the application of special knowledge of the mathematical, physical and engineering sciences to such professional services or creative work as consultation, investigation, evaluation, planning, design, and supervision of construction for the purpose of assuring compliance with specifications and design, in connection with any public or private utilities, structures, buildings, machines, equipment, processes, works, or projects.

"A person shall be construed to practice or offer to practice engineering, within the meaning and intent of this Act, who practices any branch of the profession of engineering; or who, by verbal claim, sign, advertisement, letterhead, card, or in any other way represents himself to be a professional engineer, or through the use of some other title implies that he is a professional engineer; or who holds himself out as able to perform, or who does perform, any engineering service or work or any other professional service designated by the practitioner or recognized by educational authorities as engineering."

This matter was considered by the Board at its Chicago meeting and the definitions were formally approved.

Industrial Disarmament of Aggressor States (Germany)

Report of the National Engineers Committee of Engineers Joint Council

September 24, 1945

To the Members of the Executive Committee of the Engineers Joint Council:

Mr. Malcolm Pirnie, *Past-President, American Society of Civil Engineers*

Mr. Harvey S. Mudd, *President, American Institute of Mining & Metallurgical Engineers*

Mr. Robert M. Gates, *Past-President, American Society of Mechanical Engineers*

Mr. Charles A. Powel, *Past-President, American Institute of Electrical Engineers*

Dr. Lawrence W. Bass, *President, American Institute of Chemical Engineers*

Gentlemen:

In compliance with the request of the Engineers Joint Council of February 12, 1945, supplemented by the approval of the State and War Departments, the undersigned committee reports its conclusions with regard to measures for the postwar control of German industry as outlined by the Yalta-Potsdam agreements:

YALTA "It is the purpose of the United Nations to destroy German militarism and nazism and to insure that Germany will never again be able to disturb the peace of the world. We are determined to disarm and disband all German armed forces; break up for all time the German general staff that has repeatedly contrived the resurgence of German militarism; remove or destroy all German military equipment; eliminate or control all German industry that can be used for military production.... To build in cooperation with other peace-loving nations, world order under law, dedicated to peace, security, freedom and the general well-being of all mankind."

POTSDAM "The purposes of the occupation of Germany by which the control council shall be guided are: The complete disarmament and demilitarization of Germany and the elimination or control of all German industry that could be used for military production.... All arms, ammunition and implements of war and specialized facilities for their production shall be held at the disposal of the Allies or destroyed. . . .

"In order to eliminate Germany's war potential, the production of arms, ammunition, and implements of war as well as all types of aircraft and seagoing ships shall be prohibited and prevented. Production of metals, chemicals, machinery and other items that are directly necessary to a war economy shall be rigidly controlled and restricted to Germany's approved postwar peacetime needs .... Productive capacity not needed for permitted production shall be removed in accordance with the reparations plan recommended by the Allied commission on reparations and approved by the governments concerned or if not removed shall be destroyed. .... In organizing the German economy, primary emphasis shall be given to the development of agriculture and peacetime domestic industries. . . .

"Allied controls shall be imposed upon the German economy but only to the extent necessary: . . . To control German industry and all economic and financial international transactions, including exports and imports, with the aim of preventing Germany from developing a war potential. . . . To control all German public or private scientific bodies, research and experimental institutions, laboratories, et cetera, connected with economic activities."

It is the function of this Committee to recommend measures to fulfill these objectives. To this end it is essential to identify the critical war potential elements in German industry so they may be eliminated or controlled, thereby safely permitting the non-war potential portion of German industry to function.

Submitted by the National Engineers Committee of the Engineers Joint Council.

Robert E. McConnell, *Chairman, New York*

Harry S. Rogers, *Vice-Chairman; President, Brooklyn Polytechnic Institute, Brooklyn, N.Y.*

Thomas F. Barton, *Commercial Vice-President, General Electric Co., New York*

Carlton S. Proctor, *Consulting Engineer, New York*

Dr. Edward R. Weidlein, *Director, Mellon Institute of Industrial Research, Pittsburgh, Pa.*

Dr. Clyde E. Williams, *Director, Battelle Memorial Institute, Columbus, Ohio*

Outline of Policy

Eliminate Fundamentals of Aggressor Nations' War Potentials

The issue in Total War is supremacy. There is no lesser objective. The outcome of Total War must be achievement, by the victor, of the power to dispose of issues, by force if necessary, during the postwar period of adjustment between victor and vanquished. History has proven that the perversion of morals and ideas, in which Total War has its inception, will continue as a dominant characteristic of aggressor peoples for many years. Unless the United Nations retain the power, through good will, collaboration, and force, to dispose for the aggressor peoples, of inflammatory issues, man will be enmeshed in continuing conflict. Military victory by peace-loving nations is, therefore, not enough. There must be subtracted from the aggressor peoples, for a long period of recuperation, the fundamentals of their industrial war potential for armed aggression.

Attempted Elimination of All German Industries Would Produce Social Chaos

Elimination of German industries, leaving agriculture as the sole occupation, would produce an economic dislocation and social chaos of destructive magnitude, not alone in Germany but throughout Europe. Adequate enforcement would be practically impossible. Furthermore, severe restrictions of this nature probably would be repudiated by world public opinion in a relatively short time, resulting in a repetition of the aftermath of World War I.

Simplify Fundamental Control Policy

It is obvious that such controls as are imposed must be effective, practicable, and should require a minimum of policing. They must be of a character that will remain effective for a considerable period after large-scale military occupation of the country has been discontinued. Therefore, these recommendations are directed, in so far as feasible, to fundamental control policies, rather than specific and detailed regulatory measures.

Essentials of Control of War Potential Industry

All industrial processes, regardless of whether they are operated for peaceful or aggressive purposes, are based on three essential factors, without any one of which operation would be impossible, to wit, energy, raw materials, and processing equipment. The hereinafter recommended regulations of Control of German Potential War Industry based on these essential factors are:

I A broad primary control, based on allocation of energy

II Raw-material elimination or limitation, applied to specific elements critical to war industry,

III Processing, fabricating and new construction controls, plus supplemental measures based on control of:

IV Scientific research, and

V Economic subsidies.

The objective of these five controls would be the elimination or limitation of all German industry that could be used for military production. To define such industries this report will deal with the elementary raw materials required in such industries.

Overall Importance of Coal to German Industry

In addition to being the prime source of energy for German industry in general, coal serves as a critical raw material for many industries that are vital to German economy in either peace or war

The coal tar resulting from the production of coke is the basic raw material for the enormous and diverse organic chemical industry which the Germans have developed. Originally the coal tar was considered a by-product, but the dominance of the chemical industry has reversed the situation so that the coke is now considered the by-product. This is demonstrated by the fact that the iron and steel industry has been subsidized, not only for Germany's armament programs, but to utilize the coke, converting it into a more valuable medium of exchange, and in spite of this there has been excess coke available for exportation.

Coal is likewise the foundation of the other industries because it is the only adequate source of carbon. The German nitrogen fixation industry is in reality based on carbon. This element is essential in the separation of nitrogen from the air by the fixation of oxygen in the producer gas reaction; in the production of hydrogen by the fixation of oxygen in the water gas reaction; and in the production of calcium carbide in the cyanamide process.

The German synthetic fuel industry is also based on coal (carbon). The lack of adequate resources of petroleum has created the synthetic oil industry, in which coal, or coal tar, is hydrogenated to produce lubricating oils and motor fuels. A more fundamental branch of this industry consists in converting the carbon monoxide which, by combination with hydrogen in the Fischer-Tropsch process, leads to the synthesis of fuels, oils, and many other organic compounds. Although these processes have to date been uneconomical to the extent that they have required subsidizing to compete with petroleum products, current developments indicate that costs may be reduced so that they can compete without subsidy.

Furthermore, coal will remain the principal German natural resource, and if German industry is to be encouraged for peaceful development and the German nation encouraged to national self-support, it appears that a full development and usage of German coal must be encouraged, since peaceful industrial development will continue to depend upon coal and its many by-products. German coke and coal will also continue to be required for the industrial development of Germany's neighboring nations. Germany derives approximately 85% of its energy, as power and light, from coal, directly or indirectly; the balance is derived from hydroelectric developments.

It is probable that the domination, allocation and strict control of German coal and its uses would provide an effective control of all German industry. But since the peaceful industries of Germany should be encouraged while war industries are prevented, such a single overall system of control would become involved and conflictive. The most effective system of control of German industry, to accomplish this dual purpose must therefore include:

(1) control of the uses of coal as energy and as a raw material,
(2) the control of electric power at its source,
(3) effective prohibition and prevention of the production of materials of war, and
(4) the control of raw materials.

It is the object of this discussion to demonstrate that coal is the pivotal point of the German economic structure because of its vital function, as the prime source of energy or as an essential raw material.

Coal, as one of Germany's exportable commodities, should be controlled by the same body that controls other raw materials.

Electric Power

It is recommended that a comprehensive postwar control of German industry be based on a system of energy allocation.

The fundamental factor is energy, since it is required in one form or another to operate all processing equipment for the transformation of all raw materials into finished goods. Therefore, regulations based on energy are so inclusive that all industrial operations fall within their scope.

Control of power distribution through allocation of all coal distribution, while fundamentally effective, would be cumbersome, a handicap to peaceful development and would require a considerable staff. A rigid control of electric power distribution is therefore important to ensure compliance and regulation of German industry.

The specific details of electric power allocation must be formulated by the Control Council in Germany possessing first-hand information of the requirements of German industrial and domestic activities. It is assumed that after productive limitations, consistent with the recommendations herein contained, have been determined for German industry, it will be relatively easy to ascertain the energy requirements to supply industrial and domestic needs. All excess capacity above that allotted to a given district, including installations in industrial plants, should be removed and all of the contiguous auxiliaries, building foundations and other services should be removed or destroyed. It should be realized, however, that the electric-power industry in Germany cannot and should not be used as the sole means of controlling other industries for disarmament purposes. Reports on the use of electric energy by individual manufacturing plants cannot be relied upon as a definite indication of the magnitude and nature of manufacturing operations.

Reprints of Complete Report Available

The complete report is given here, except for the appendices, consisting of letters of authorization and terms of reference, plus 19 tables of pertinent data. In complete form, including these appendices, the report is available on request to Society Headquarters, 33 West 39th Street, New York 18, N.Y.

Raw Materials

In the long list of components of modern war there are several required in such quantities and so critical that without them modern war would be impossible, even if ample energy were available. They may be considered the primary raw materials of war industry. Modern air power would be non-existent without aluminum. Modern land and sea power would be non-existent without steel and steel alloys. Modern air and land power and, to a lesser degree, sea power, would be immobilized without liquid fuel and lubricants. However, planes, ships, tanks and guns—all instruments of war—serve a single purpose, that of conveying explosives to given objectives. Therefore, without explosives the instruments of war will be useless as weapons of destruction.

Nitrogen

All military explosives used in effective quantities prior to the development of the atomic bomb have been derived from nitrogen. Although the atomic bomb has been developed and used with devastating effect, nitrogen will probably continue to be a principal ingredient of military explosives. Regulation of German nitrogen fixation facilities is therefore of primary importance.

The chief source from which a nation, bent on aggression, can obtain self-sufficient supplies of nitrogen is through the chemical fixation of this element. The large-scale development of chemical nitrogen fixation in Germany prior to 1914 made it feasible for that nation to engage in World War I. The maintenance of this industry in Germany, and its further expansion after the first world war, made World War II possible.

The fixation of nitrogen in Germany is practically dependent upon coal for energy, and as a critical raw material in the form of carbon, so that regulation of German coal would provide a regulation of the fixation of nitrogen. However, because of the vital nature of nitrogen as an instrument of war, this industry should be eliminated in Germany with such minor exceptions as are hereinafter stipulated.

The German nitrogen industry has been an almost negligible factor in providing employment.

Therefore, it is recommended:

(1) That all synthetic fixed nitrogen production, except cyanamide, within the borders of postwar Germany be eliminated, either by the enforced prohibition of the rebuilding of demolished plants, or the destruction or the removal of any remaining equipment.

That the chemical nitrogen production in postwar Germany be limited to the by-product nitrogen of the permitted steel industry, plus not over 200,000 short tons of nitrogen as cyanamide per year. Electric power allotted to cyanamide production should be controlled accordingly.

(2) That all synthetic processes and equipment suitable for hydrogenation of coal or hydrocarbon oils, and for the production of synthetic ammonia, or methanol, and in addition, any other processes for producing fixed nitrogen by low pressure methods, be eliminated within the borders of postwar Germany, except as noted in Recommendation 1 above.

(3) That the total amount of nitrogen allowed Germany through domestic manufacture and controlled import be restricted to the minimum amount necessary for agriculture and permitted industrial activity.

That the available statistics show that the consumption of nitrogen by German agriculture for the period of 1924 to 1938 averaged 481,000 short tons per year, although the German productive capacity averaged two or three times that amount for the same period. The postwar nitrogen requirement of German agriculture should be determined at appropriate intervals by United Nations soil and fertilizer experts, on the basis of the crops grown.

The needs of Germany for agricultural nitrogen in excess of the recommended domestic production can be supplied in the form of synthetic and natural nitrates from other countries.

Such industrial needs as require anhydrous ammonia, which cannot be advantageously transported overseas, could be supplied from plants outside Germany on the continent.

(4) That German citizens, corporations, the German government, or any instrumentality thereof, be prevented from obtaining complete or partial control or any financial interests in any nitrogen fixation plants in any country.

The vital importance of complete execution of these recommendations cannot be overemphasized when the prospects of postwar German industrial activity, even though limited, are viewed against the history of the last two wars. The intellectual fiber of the German survivors of this war is such that German heavy industry, plus nitrogen fixation facilities, would constitute a potential threat of war in spite of regulatory efforts.

The failure to recognize the fixed nitrogen industry as a vital key in the control of postwar Germany would be equivalent to the promulgation of a continuous state of world insecurity.

Statistics in support of these conclusions are appended. [See complete report, available in reprint form.]

SYNTHETIC OIL

The German synthetic oil industry has been maintained by subsidy for ultimate expansion into an implement of war. It is likewise dependent upon coal, not only for energy but also for the essential raw material carbon in various forms. Therefore, this industry, like the nitrogen fixation industry, could be automatically regulated by coal control. But the synthetic oil should be eliminated, not only to remove a critical war potential factor from German economy, but to provide further insurance against diversion of synthetic oil equipment to production of explosives, for synthetic oil and gas equipment can, with certain modifications, be used for nitrogen fixation.

Liquid fuels, which are primarily either oil products or synthetic products which are similar, are vital for fighting a war under present-day conditions. Without such liquid fuels no airplanes can be flown, no tanks operated, and there can be no mechanized transport. The need for liquid fuels for conduct of war will undoubtedly increase and it seems unlikely that they can be effectively replaced.

Processes for production of synthetic fuels used in Germany before the war required much heavy equipment and represented a large investment per unit of capacity, but employed a negligible labor force. Assuming that Germany's wartime synthetic fuel manufacturing facilities were destroyed, the investment required to create a comparable synthetic fuel industry to produce 150,000 bbl per day of liquid fuels would probably be of the order of 700 million to 1 billion dollars. This represents a very large industrial development and one that would require a considerable length of time to build and put into successful operation. For comparison, the development of a synthetic rubber industry in the United States has involved an expenditure of about 700 million dollars, and took from two to three years to build and put into operation. Furthermore, no other European country has found it economical to develop a synthetic oil industry.

It is recommended that Germany's synthetic fuel industry be entirely eliminated. It will be unwise to allow any part of the industry to exist, as this would tend to maintain Germany's knowledge and technique of manufacture, and would give a foundation for rapid expansion and conversion to a definite war potential.

ALUMINUM

For all practical purposes the German aluminum industry has been government owned since World War I, and has been maintained by subsidy, in one form or another, for its ultimate expansion into an implement of war. There are no bauxite or commercial alumina bearing ores within Germany proper, which fact has necessitated practically a 100% importation. Germany has no substantial amount of water power so that all metallic aluminum has been smelted by the use of electricity generated from coal. All of these factors combined to make German metallic aluminum uneconomical, and hence it had no competitive value in the world market. It has been estimated that Germany could have imported aluminum for about half the cost of its domestic production.

The German aluminum smelting industry has been an almost negligible factor in providing employment. Based on modern smelting operations in the United States it has been estimated that in the German industry in 1932 (at which time it was assumed that of the 47,178,000 lb smelted about 40,000,000 represented normal peacetime domestic consumption) about 400 persons were required.

It is readily apparent that on a peacetime basis the German aluminum production industry contributed little to the economic structure of the world, and could be eliminated with no ill consequences. Furthermore, until the character of the German people is changed and their will to wage war is diminished, they may be expected to attempt to evade regulatory measures; therefore, it would be impractical to consider any limitation on the smelting of aluminum ore other than complete prohibition.

Specific recommendations as to the amount and type of aluminum that Germany should be allowed to import for domestic peacetime consumption, or as to the advisability of permitting Germany to export fabricated aluminum goods to improve its exchange position, are not within the scope of this report. However, with other fundamental war potential factors under rigid United Nations control, Germany may safely be allowed a light aluminum fabrication industry provided that suitable limitations are placed on the quantity of aluminum imported, on the size and type of the equipment used in fabrication, and on the scrap resulting from the fabrication.

Therefore, it is recommended:

(1) That all alumina producing and smelting plants within the borders of postwar Germany be eliminated, either by demolition or removal in accordance with the recommendation of the Reparations Commission.

(2) That importation of bauxite or any alumina ores, be prohibited, except for a limited amount to be used as such without smelting, as provided for hereinafter under import regulations (Recommendation 8).

(3) That the production of petroleum coke and carbon paste be prohibited. The electrical process for smelting aluminum requires about .75 lb of carbon for electrodes per pound of aluminum.

(4) That the control of energy be studied by competent engineers to determine the practicability of exercising long-term regulation by the rationing of coal to generate power, either as steam or electricity, or exercising instantaneous regulations by control of electricity at central distributing stations. With the elimination of the smelting of bauxite this control would have its most direct application to the fabrication industry.

(5) That the aluminum fabrication industry in postwar Germany be restricted to light industry, such as the manufacture of consumer goods. The control in this case may be exercised by limitation of size and type of manufacturing equipment.

(6) That a quota for the quantity of aluminum and aluminum scrap to be imported by Germany be determined by competent authorities. It is further recommended that this

quota be flexible and subject to periodic review and adjustment by the United Nations Control Council or some division thereof.

(7) That aluminum and scrap now stocked in Germany be seized and distributed in accordance with the foregoing plans.

(8) That the quantity of alumina used as such and aluminum compounds normally used in peacetime in such industries as the ceramic, manufacturing and chemical be determined and a quota based thereon, and such items be admitted up to this quota without special import license. The total amount of aluminum used in this form is small, and without smelting facilities could not be converted into metallic aluminum.

IRON AND STEEL

The iron and steel industry was of basic importance in the prewar German economy and was surpassed only by the United States in output. The industry was developed and expanded under state auspices by means of tariffs, cartels and subsidies, ostensibly for economic progress but actually as an integral part of the creation of a war potential industry. Domestic prices of steel products were 75–100% above export prices except to manufacturers of goods for export, who obtained rebates for the difference between export and domestic prices.

Exportation of steel products had a quadruple function:

(1) to create a reserve capacity for production of steel—an integral part of the war potential program;

(2) to create a reserve of skilled metal workers;

(3) to provide for importation of goods, both for civilian consumption and war stock-piling;

(4) to subordinate other countries to its economy by means of dominating their trade.

Germany's principal advantage in the steel industry was possession of the greatest supply of coal in Europe, including high-grade coking coal. The domestic iron ore is low grade and inadequate for steel production. 80% of the ore consumed, based on metal content, and practically all of the alloying metals, were imported prior to the war. The net result was that the German steel industry competed in the world market only with the support of cartels and subsidies.

The number of workers directly engaged in the production of steel, that is, in blast furnaces, steel smelting and rolling mills, exclusive of coal, coke and other raw materials, probably did not exceed 175,000 in 1937, or approximately 1/2 of 1% of the total number of German workers. However, the consumption of steel in Germany probably affected directly 7.5 million workers in the heavy industries and, indirectly, all workers, because of the tools and instruments furnished other industries.

The production of steel, the use of alloys, and the manufacture of goods by heavy industries are essential to common welfare. Germany, however, expanded its production of steel far beyond that necessary for peacetime economy and utilized it for destructive purposes. Until the aggressive will of the German people has been eliminated it is essential that the steel industry, together with other war potential industries within Germany, be restricted to a level that will not support aggression.

Specific definition of this level for the steel industry is beyond the scope of this report, because of the interrelationship of numerous economic factors. However, with rigid United Nations control to provide and enforce adequate restrictions, Germany may be permitted a limited steel industry.

Therefore, it is recommended:

(1) That the productive iron and steel capacity of postwar Germany be reduced to a level sufficient only for domestic peacetime needs. Definition of this level should be the function of the United Nations Control Council and it should be subject to periodic review by the Council, with such revision as is consistent with the standard of living within Germany.

(2) That the importation of iron or iron ore, and alloys or alloy ore be restricted in accordance with the foregoing quota.

(3) That the importation of raw materials pertaining to the iron and steel industry, the manufacture and distribution of the finished goods, be regulated by a "Controlled Materials Plan" such as recommended for the aluminum industry.

(4) That the re-equipment of the German steel industry be studied by steel experts of the Control Council for the purpose of eliminating such equipment which, because of its type or size, could be converted readily to the production of instruments of war.

(5) That all duties, cartel arrangements and state subsidies for steel, or goods and services entering into its manufacture, be prohibited.

REGULATION AND CONTROL OF FUTURE CONSTRUCTION

Evasion of the regulations and controls herein recommended, intended for illegal production of war potential raw materials, would require large installations, as for example, facilities for the production of fixed nitrogen, synthetic oil, aluminum, steel and atomic energy.

Energy controls might be effective for the regulation of established industry, but new plants will be built, and it is therefore necessary to assure that such plants may not be convertible into war plants. Therefore, the rigid control of all new construction should be maintained through the issuance of permits by a Board of Construction Control, composed of experts in all potentials of war production.

It is recognized that the principles of atomic energy may be known to German scientists during the period of the contemplated tenure of these regulations, but it is believed that control of such development will be readily obtained through the rigid regulation of all construction and control of power requirements, to preclude the possibility of construction of plants for the development of such atomic energy.

SUPPLEMENTAL CONTROLS WITH SIMPLIFIED IMPORT LICENSING

To be completely effective, the control of raw materials critical to war potential industries must include an import licensing system to regulate the nitrogen imported as fertilizer, petroleum and liquid fuels, aluminum, steel, and any other materials which might contribute to war potential. This system should be operated on the basis of a "Controlled Materials Plan" requiring every individual, concern or manufacturer handling any of these items to state in complete detail the quantities and type of material required, the nature and disposition of the finished product, and the scrap resulting from fabricating operations. Any of the materials licensed by this system would be considered "in bond" and the possession of any such materials unauthorized by the proper documents would be illegal. Such a system is considered essential to eliminate attempts to stock-pile these materials, especially scrap, and to counteract the inevitable effort of Germany to obtain participation in, or control of, foreign plants for the purpose of shipping critical materials into Germany under the guise of German ownership.

PROCESSING AND FABRICATING REGULATIONS

Supplemental control of certain specific equipment and the scale of operation, within the restricted portion of war potential industries remaining in Germany, are necessary to eliminate from Germany some tools and machinery that could be readily converted to the production of war implements, or that could fabricate materials of such shape or size that they could be readily converted to war implements.

Such regulations apply to the tools and machinery of the aluminum fabricating and steel industries or any other industries in which such steps are considered necessary. Specific details should be set up by experienced engineers of the Control Council with first-hand knowledge of the type of equipment in German plants and the extent to which the plants will be permitted to function.

SCIENTIFIC RESEARCH

Supervision of the Coordination or Integration of Component Research Programs

All of the control measures thus far outlined have been directed toward the regulation of energy, existing materials, and equipment and processes as utilized in the European Theatre of World War II. Scientific research, however, has been fundamental to the development of all military weapons, and will likewise be the source of future weapons. No comprehensive regulations can be made to limit research, since it lies within the intangible fields of ideas. However, major scientific developments originating from secret

research may be made difficult or even impossible, by preventing the coordination of research and development of facilities under a single German administrative control. All such activities should be reduced to as small units as can effectively perform the work assigned them, and confined, where practicable, to a single field. The necessary coordination between the individual units should be made only with United Nations supervision.

Economic Subsidies

The initial success of the German war plans, considering the relative deficiency of natural German resources, has been due in large part to the maintenance by subsidy of industries essential to a rearmament program. In this category are the nitrogen, the synthetic liquid fuel, the aluminum, and the steel industries, all of vital importance to a modern war machine. They were subsidized to keep them under German control, not only for conversion to production of war implements, but so that in time of war Germany would be self-sufficient.

It is probable that had Germany been without these industries the deficiency could have been met, in part at least, by substitutes, but not to the degree necessary for a world war.

Therefore, if postwar German industry is to be limited to economically efficient units, certain of the major war potential industries will be either eliminated or reduced to a status ineffective for war. To accomplish such control, provision should be made to audit regularly all government receipts and expenditures to prevent diversion of funds for subversive purposes.

Conclusion

If the Control Council in Germany will institute and maintain effective controls of power production and distribution and industrial plant construction to

(1) Prohibit the synthetic fixation of nitrogen;
(2) Prohibit the production of synthetic liquid fuels;
(3) Prohibit the production of aluminum;
(4) Prohibit the use of atomic energy;
(5) Limit the capacities and production of steel and steel products plants,

such procedures will establish a considerable measure of assurance against the danger of German rearmament.

Employment of the total German peacetime labor force will be reduced about five per cent by the prohibitions and controls herein recommended. There should be no serious problem in the reemployment of such a small percentage of labor in German peacetime agriculture and consumer goods industries.

These recommended procedures are not intended as a substitute for the protection afforded by an adequate police force of the United Nations in Germany. Freedom from fear of rearmament will be attained only so long as such a police force remains in authority.

For the guidance and direction of the policing forces, there should be established a group of technological specialists who will keep informed as to German industrial and research activities.

Walter E. Jessup to Represent the Society in the West

AT THE Board's Chicago meeting it was reported that Lt. Col., Walter E. Jessup, following release from the Army, is returning to the Society staff. He will represent the Society in an office to be opened in Los Angeles, where he lived for a number of years. During the war Colonel Jessup was stationed first at Fort Belvoir, Va., as a training officer in the Engineer Replacement Training Center. From this service he was transferred to the Office, Chief of Engineers, and assigned to staff supervision over the preparation of all publications and visual aids used in the training of troops in engineer tactics and techniques; and in the operation maintenance, and repair of engineer mechanical equipment.

Because of his familiarity with Society problems and procedures, his services in his new position should be particularly valuable. He came to the Society first in 1930 as editor of CIVIL ENGINEERING, following some years of practice in Southern California, largely as a consulting engineer. In March 1935 he was transferred to the position of Field Secretary, in which position he traveled widely throughout the country, primarily for the purpose of promoting and advising with Local Sections and Student Chapters.

Another period was spent as head of Society activities in Washington, D.C., prior to the establishment of a full-time Society office there. Still later Mr. Jessup returned to the New York office as acting Assistant Secretary. It was from this position that he went into the Army in July 1942.

During his residence in California he served as president of the Los Angeles Section. He has maintained many of his contacts, including those which he developed in the course of his travels for the Society. After spending some time in familiarizing himself with current Society problems at Society Headquarters, he expects to take up his western duties in November.

Georgia Section Assists in Construction Survey

SURVEY of the Atlanta, Ga., metropolitan area has recently been made to determine probable construction volume in the five-year period ending in 1950. Projects totaling more than $310,000,000 have been listed. The projects included in this list are those which are planned definitely, so that the report as released is characterized as "very conservative."

Sponsored by the Committee for Economic Development, the survey was carried out by a committee composed of members of the Georgia Section, Am. Soc. C.E., and Atlanta business executives. J. C. Prather, local construction chairman of the C.E.D., directed the survey, while the working committee was headed by Co-chairmen Paul Weir and C. A. Smith—all members of the Section.

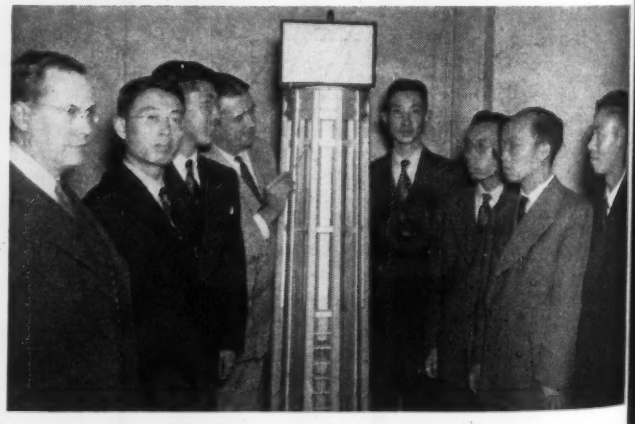
Work to be undertaken includes commercial buildings, highways, bridges, sewers, airports, college facilities, churches, schools, and industrial plants. The complete list of projects has been kept confidential at the request of certain private and public agencies who have felt it a disadvantage to disclose all plans at this time.

In a report before the Georgia Section, Chairman Prather estimated that both production and employment in the area would exceed by nearly 30% the volume reached in prewar years. He gave convincing reasons for predicting a building boom extending beyond the five-year period studied.

Chinese Engineers Who Visited Society Headquarters

FIVE of the six young Chinese civil engineers shown in the photograph spent Saturday and Sunday, October 6 and 7, in New York inspecting water supply and hydraulic structures in the vicinity. They had been referred to Society Headquarters by Assistant Commissioner of Reclamation Kenneth Markwell, M. Am. Soc. C.E., who, in the picture, is pointing out some of the features of a model of one of Boulder Dam's intake towers.

These Chinese engineers are all graduates of Chinese universities and hold engineering degrees, with special emphasis on hydraulics. They are in the age group of 28 to 33 and have had an average of about 6 years of practical experience in engineering work in China. All expressed keen interest in the American Society of Civil Engineers and in the possibility of becoming members.



NOTES FROM THE CAPITAL

Occasional Information Transmitted by the Society's Washington Representative and Believed to Be of Special Interest to Civil Engineers

St. Lawrence Seaway Project Again Before Congress

IN A MESSAGE to the Senate on October 2, President Truman recommended speedy approval of the agreement between the United States and Canada for the development of the St. Lawrence Seaway and Hydroelectric Project. Favoring enactment of legislation pending, the President contended that "Every engineering investigation during the past 50 years, every economic study in the past 25 years, has found the project feasible and economically desirable. The case has been proved; the plans are ready."

Political controversy, which has in the past balked favorable consideration of the project, still rages. New factors to be considered, however, are the facts that the President has given it his wholehearted support, and that Governor Dewey of New York has demanded early action. Present discussions directly concern Senate approval of an agreement made on March 19, 1941, between the United States and Canada providing for construction of canals, locks, and dams for the improvement of navigation through the St. Lawrence valley from the Great Lakes to the Atlantic. Another phase of the agreement is the installation of power-generating equipment utilizing water power from the St. Lawrence.

Total cost of the project has been estimated to reach more than $421,000,000. Costs would be shared by the United States and Canada—about $277,000,000 and $144,000,000, respectively. The Canadian share is considerably smaller because that government has already constructed a large part of the facilities needed, including the Welland Ship Canal connecting Lakes Ontario and Erie. Still needed to complete the Seaway Project are channel deepening in several sections, locks, and other navigation facilities in the reach from Montreal to Lake Ontario.

Power development planned as a part of the project has been a stumbling block for proponents of the agreement. Control and marketing of the 2,200,000-hp planned has stirred up many bitter debates. In his message to the Senate, President Truman stated his position clearly: "It has always been understood by the responsible proponents of this development that the water-power project should become the property of the State of New York, and that the electric power should be developed and handled by the State. That should continue to be the policy, and I recommend that it be so declared by the Congress."

This arrangement between the federal and New York State governments is expressed in an accord of 1933. One condition of this accord assigns the American portion of the developed power to a State Power Authority. In return, the Authority would reimburse the federal financing agency to the extent of $93,375,000, the cost of the power installation. This money would be raised by marketing the power.

Substantiating his position on the project, the President said, "The St. Lawrence Seaway will make it possible to utilize our war-expanded factories and shipping facilities in the development of international economic cooperation and enlarging world commerce. New and increasing opportunities for production and employment by private enterprise can be expected from this cheap water transportation."

John Fritz Medal Goes to Mining Engineer

THIS year's recipient of the John Fritz Medal, sometimes called the highest award of the engineering profession, goes to Dr. Zay Jeffries, member and former president of the American Institute of Mining and Metallurgical Engineers. Dr. Jeffries, who is vice-president of the General Electric Company in charge of the chemical department at Pittsfield, Mass., receives the award for "leadership in the solution of problems affecting the production, conservation, substitution, and scientific appraisal of metals and alloys."

Born in Willow Lake, S.Dak., in 1888, Dr. Jeffries graduated from the University of South Dakota in 1910, and subsequently did graduate work there and at Harvard. He enjoys an international reputation as a metallurgist, particularly with regard to non-ferrous metals, and as consultant in electrochemical and electrometallurgical work. He has been with the General Electric Company in various capacities since 1914.

The John Fritz Medal, established in 1902 by the Four Founder Societies for notable scientific or industrial achievement, is international in scope, having been awarded to Lord Kelvin and Marconi as well as to such Americans as Thomas A. Edison, George W. Goethals, and Orville Wright. The Board of Award consists of four past-presidents of each of the Four Founder Societies. Presentation of the medal will be made at a forthcoming meeting of the American Institute of Mining and Metallurgical Engineers.

New American Standard Promises Progress and Economy in Building Field

A FUNDAMENTAL development in building design and construction has occurred with the recent issuance of a new American standard, approved by the American Standards Association. As a result, building materials and equipment of coordinated sizes and dimensions will be made available, and building plans and details can be correlated with these dimensions. This will open the way to improved quality and reductions in cost, as it will eliminate much cutting and fitting on the job, perceptibly reduce the number of sizes of building products to be manufactured and carried in inventory, and generally simplify the design and detailing of buildings.

This new American Standard is A62.1-1945, "American Standard Basis for the Coordination of Dimensions of Building Materials and Equipment." This is the basic standard. Supplementary to it is A62.2-1945, "American Standard Basis for the Coordination of Masonry."

Project A62 is a cooperative effort of the building industry, authorized to include:

1. Development of a basis for the coordination of dimensions of building materials and equipment, and the correlation of building plans and details with such dimensions.
2. Recommendation of sizes and dimensions as standards suitable for dimensional correlation.

The A62 Committee appreciates the importance of furnishing designers and users with authentic information as to what particular sizes and dimensions meet all the requirements of dimensional coordination. The committee will do all it can to expedite the adoption and publication of supplementary American Standards embodying such sizes and dimensions. However, industrial organizations and manufacturers of the lines concerned will be the most widespread source of such information. Current sources of information, in addition to producers and their representatives, are the following:

For brick and clay tile, the Structural Clay Products Institute, 1756 K Street, N.W., Washington, D.C.

For concrete masonry products, the National Concrete Masonry Association, 33 West Grand Avenue, Chicago 10, Ill.

For metal windows, the Metal Window Institute, Cheltenham, Pa.

For wood windows and sash, the National Door Manufacturers Association, 332 South Michigan Avenue, Chicago, Ill.

Information for designers and users will be included in the *A62 Guide*, preparation of which is being rushed. This will give the engineer, architect, and builder needed data on building layout and details. Pending completion of the *Guide*, the following material on dimensional coordination is available:

ASA Project A62, published in August 1941, can still be secured from the American Institute of Architects, 1741 New York Avenue, Washington 6, D.C., or from the Modular Service Association, 110 Arlington Street, Boston 16, Mass. This discussion of the development of dimensional coordination is instructive, but some of

the detailed drawings have been superseded by later developments.

Modular Coordination as Related to Building Design is the statement initially issued by the A62 Executive Committee in June 1944, under the title of "Modular Planning as Related to Building Design." It was published by the Producers' Council, Inc., and distributed with Technical Bulletin No. 46. It is being revised to include the latest developments in steel and wood window coordination. Copies will be available from the Producers' Council, Inc., 815—15th Street, N.W., Washington 5, D.C., or from the American Institute of Architects, 1741 New York Avenue, Washington 6, D.C.

Dimensional Coordination, an article by M. W. Adams, and Prentice Bradley of the Modular Service Association, appeared in the *Journal of the American Ceramic Society* (Vol. 28, No. 8, 1945). Reprints are available from the Modular Service Association, 110 Arlington Street, Boston 16, Mass.

For further information, consult the Chairman of the Publicity Committee for Project A62, J. W. Follin, Assoc. M. Am. Soc. C.E., Managing Director, The Producers' Council, Inc., 815—15th Street, N.W., Washington 5, D.C.

Gerard H. Matthes Honored by Mid-South Section

A DINNER meeting of the Mid-South Section was held in Vicksburg on October 4. This meeting, held jointly with a session of the Engineers' Club of Vicksburg, was arranged for the express purpose of honoring Gerard H. Matthes, Hon. M. Am Soc. C.E. On October 1, Mr. Matthes retired from government service. After 50 years of varied engineering assignments which have brought him international recognition, he has availed himself of the opportunity to devote at least a portion of his time to the preparation of a treatise on river engineering, with which he is so familiar.

His many contributions to the science of hydraulic engineering and his patient and understanding interest in the problems of younger engineers were given much deserved recognition by Willard J. Turnbull, M. Am. Soc. C.E., who has been a member of Mr. Matthes' staff at the U.S. Waterways Experiment Station. For the main feature of the program, Mr. Matthes gave his lecture on the "Hydraulics of the Holland Dike System." This lecture presented the problem which has confronted and is confronting Holland in protecting its lands both from the sea and from the flood waters of the Rhine, Meuse, Amstel, and Schelde rivers. Illustrating his remarks with slides, Mr. Matthes traced the evolution of Holland from its earliest history, when it consisted principally of a chain of sea islands and swamps, to its present productive area. The constant vigilance required to prevent the sea from once more invading the territory was stressed, and the methods and features developed for the reclamation of the land were described in detail. The lecture as presented by Mr. Matthes was of exceptional interest and is viewed as an outstanding technical presentation.

Other honored guests were Mrs. Matthes; Gen. Max C. Tyler, M. Am. Soc. C.E., president of the Mississippi River Commission, who will soon retire from office; and Mrs. Tyler. Lt. Col. C. P. Lindner, president of the Mid-South Section, who succeeds Mr. Matthes as director of the U.S. Waterways Experiment Station, paid glowing tribute to General Tyler on behalf of the Section. A resounding ovation was given to both General Tyler and Mr. Matthes for the persistent support they have given to the Mid-South Section and the Engineers' Club of Vicksburg during their many years in Vicksburg.

No Anonymous Letters

RECENTLY the Editor received a letter from "A Sailor, USNR, formerly engineering designer." The writer of the letter stated that he is a Junior, Am. Soc. C.E. His letter was a well-phrased and heated "gripe" about the misplacing and mishandling of scientific personnel by the Navy. He wanted the letter published, but it could not be printed in CIVIL ENGINEERING because it was not signed.

It has been the long-established rule that anonymous letters from members or others will not be printed in these columns. Any person writing a letter which he wants published is required to sign his name to it. If he desires his name withheld in the printed form, and so states, his request will be granted and his identity will be held in strict confidence by the Editor. Anonymous letters cannot be published under any circumstances.

Veterans' Guide to Be Circulated

ISSUED by the Committee on Opportunities for Veterans in the Construction Industry, a booklet is to be circulated among interested veterans of the Armed Forces on their discharge. The guide defines clearly the various occupations within the construction industry and gives advice as to the best ways of finding employment in such occupations. Although aimed directly to serve the needs of prospective employees, a section has been set aside to inform employers of the training which many veterans have had while in service.

Twenty-two organizations, including the American Society of Civil Engineers, have cooperated in preparing the booklet. The chairman of the committee is E. L. Chandler, Washington Representative of the Society.

Navy Films Available

Arrangements Made to Distribute Motion Picture Films to Local Sections and Student Chapters

SPLENDID cooperation on the part of the Navy's Bureau of Yards and Docks has made it possible to show movies prepared by the Bureau at meetings of the Society's Local Sections and Student Chapters. A wide variety of subjects of special interest to civil engineering groups has been selected for such distribution. Included are documentary films of Seabee accomplishments, descriptive accounts of base construction, and such "how-to-do-it" subjects as the step-by-step construction of a pre-stressed concrete tank.

These films, all sound, some in color and some in black and white, were shot on the job (sometimes under combat conditions) by Navy photographers. Excellent film editing produced a series of well-planned, instructive as well as impressive, movies. They have been used as training aids in the services and to some extent for purposes of public relations.

In arranging to show any of the films, local groups should correspond directly with Society Headquarters at 33 W. 39th Street, New York 18, N.Y. The films, selected from the following list, should be reserved well in advance of the scheduled date of showing. All are 16-mm and can be shown only on a sound projector.

Film No. 5,000—Seabees, the Navy's Fighting Construction Men the World Over. This film, running 47 minutes, is a documentary one showing the general accomplishments of the Navy's Construction Battalions. Each type of operation is covered in brief shots.

Film No. 5,001—Seabees in Normandy. The contribution of the Construction Battalions in landing on Normandy's beaches is shown by this film, running 24 minutes.

Film No. 5,002—Seabee Report from the European Theater. In the 30 minutes this film runs, landing operations and base construction in Tunisia, Salerno, and Normandy are shown. Repair bases, construction and use of pontoon causeways, are among the subjects covered.

Film No. 5,003—Earth Movers. Uses of all types of earth-moving equipment are shown in the 20-minute length of this film. Many types of problems are encountered and helpful suggestions made for unusual uses of standard earth-moving equipment.

Film No. 5,009—Construction of Pre-stressed Concrete Tanks. This is a "how-to-do-it" film running 30 minutes. From the surveys locating a construction site to the final grading around the finished tank, this film completely covers each step in the construction of a pre-stressed reinforced-concrete storage tank. The procedure, not exclusively military, is highly instructive to civilian constructors.

Film No. 5,010—Graving Drydock Construction by Tremie Method. Step by step, for 30 minutes, the tremie concreting of a graving dock is portrayed. Various types of docks, soils, and gates, as well as pile driving and other related work, are covered.

Film Nos. 5,026, 5,026A—Floating Drydocks for Fleet Repairs. In two reels, totaling 60 minutes of running time, the complete story of construction and use of floating drydocks is told by sound film. All types and sizes of these docks are shown and explained.

Film No. 178—Lighter-Than-Air Hangar Construction. This brief, instructive film (lasting but 11 minutes) shows typical operations in the construction of a timber blimp hangar. Various erection methods are compared, and detailed processes, such as preparation of timber joints, are explained.

Film No. 373—Construction of an Advance Base. From the landing to the completion of elaborate repair establishments, this film for 12 minutes outlines the different operations of the Construction Battalions in establishing an advance base.

Illustrated Lectures Available for Student Chapters

FOR MANY years the Society has maintained at Headquarters a group of illustrated lectures primarily for presentation before Student Chapters. No expense whatever is incurred in borrowing these lectures, as the Society pays the shipping charges both ways.

This year the list of illustrated lectures includes the following 28 subjects:

LECTURES	DATE MADE	LECTURES	DATE MADE
Aerial Photographic Mapping	1941	Holland Tunnel	1930
Bonneville Dam	1939	Miami Flood Control	1929
Boulder Dam	1938	Mississippi River Flood Control	1940
Carquinez Strait Bridge	1930	Norris Dam	1939
Cascade Tunnel	1929	Power Development at Niagara Falls	1929
Catskill Water Supply	1939	Queens Midtown Tunnel	1942
Conowingo Hydroelectric Development	1929	San Francisco–Oakland Bay Bridge	1939
Construction of Chicago Subway System*	1942	Tacoma Narrows Bridge Failure*	1942
Coolidge Dam	1930	Traffic Jam Ahead†	1944
Florianopolis Bridge	1930	Waterloo Bridge (prepared by the Institution of Civil Engineers, London)	1943
Foundation Problems of West Side Elevated Highway—New York	1939	Westchester County Park System	1935
George Washington Bridge	1935	Wheeler Dam	1939
Golden Gate Bridge	1938	Wilson Dam at Muscle Shoals	1929
Grand Coulee Dam	1940		
Hetch Hetchy Water Supply	1929		

* Includes film. † Record and film—no lecture.

Each of the lectures consists of a mimeographed talk keyed to fifty or sixty slides (except where otherwise noted). The simplest method of presentation is obviously to read the lecture while the slides are being shown. However, it is suggested that, instead, the lecturer study the material in advance so that he can use the written lecture merely as an outline for his talk, and be able to answer questions from the floor. Each lecture includes references to articles in Society publications, which may be consulted for further information on the project under discussion.

A request to Society Headquarters, reserving a particular lecture, should be sent well in advance of the date of presentation. Experience has proved that those who wait to send in such a request until the last minute are often unable to obtain the lecture desired.

Appointments of Society Representatives

ADOLPH J. ACKERMAN and A. W. K. BILLINGS, Members Am. Soc. C.E., have been appointed to represent the Society at the Second Brazilian Congress of Engineering and Industry, to be held in Rio de Janeiro, Brazil, November 15–24, 1945.

SCOTT B. LILLY, M. Am. Soc. C.E., has been appointed to represent the Society on the Executive Committee of the Engineers' Council for Professional Development. He replaces GEORGE W. BURPEE, M. Am. Soc. C.E., who, after serving for two terms, is ineligible for reappointment.

HENRY EARLE RIGGS, Past-President and Hon. M. Am. Soc. C.E., chairman; VAN TUYL BOUGHTON, and SYDNEY WILMOT, Members Am. Soc. C.E., have been appointed a committee to prepare a memoir of the late GEORGE T. SEABURY, Secretary Am. Soc. C.E.

S. S. STEINBERG, M. Am. Soc. C.E., is representing the Society on a tour to visit the Engineering Societies of the American Republics.

F. W. TUEMMLER, Assoc. M. Am. Soc. C.E., has been appointed the Society's additional representative on the Joint Committee on the National Capital.

Report of Tellers on Second Ballot for Official Nominees

October 15, 1945

To the Secretary of the
American Society of Civil Engineers

The Tellers appointed to canvass the Second Ballot for Official Nominees report as follows:

For Vice-President, Zone I		
Arthur W. Harrington	658	
Ole Singstad	623	
Void	26	
Total	1,307	
For Vice-President, Zone IV		
J. T. L. McNew	1,275	
Void	8	
Total	1,283	
For Director, District 1 (Two to be elected)		
Shortridge Hardesty	662	
Irving V. A. Huie	659	
Void	11	
Total	1,332*	
(* Actual number of ballots received, 666)		
For Director, District 2		
Albert Haertlein	337	
Void	1	
Total	338	
For Director, District 6		
William R. Glidden	331	
Void	1	
Total	332	
For Director, District 10		
Wm. M. Piatt	232	
Edwin Day Burchard	120	
Void	0	
Total	352	
For Director, District 13		
F. W. Panhorst	271	
H. H. Hall	224	
Void	1	
Total	496	
Ballots canvassed		4,774
Ballots withheld from canvass:		
From members in arrears of dues	32	
Without signature	15	
With illegible signature	0	
Total withheld	47	47
Total number of ballots received		4,821

Respectfully submitted,
DAVID G. BAILLIE, JR., *Chairman*

J. H. GRANBERY
C. G. CLOUDMAN
R. EDWARD KUHN
JAMES D. PARSONS
JOSEPH FARHI
J. MECHANIC
E. L. PAVLO
Tellers

News of Local Sections

Scheduled Meetings

ARIZONA SECTION—Annual fall meeting at the Adams Hotel, Phoenix, on November 24, at 9:30 a.m.

CLEVELAND SECTION—Dinner meeting at the Cleveland Engineering Societies Club on November 16, at 6:30 p.m.

CINCINNATI SECTION—Joint meeting with the A.S.M.E. in the Engineering Societies Building on November 6, at 8 p.m.

COLORADO SECTION—Dinner meeting at the Oxford Hotel on November 12, at 6:30 p.m.

CONNECTICUT SECTION—Dinner meeting at the Graduate Club, New Haven, on November 28, at 6:30 p.m.

DAYTON SECTION—Luncheon meeting at the Engineers' Club on November 19, at 12:15 p.m.

FLORIDA SECTION—Dinner meeting at the Seminole Hotel on November 2, at 7 p.m.

GEORGIA SECTION—Luncheon meeting at the Davison Tea Room on November 2, at 12:30 p.m.

ILLINOIS SECTION—Luncheon meeting at the Chicago Engineers' Club on November 15, at 12:15 p.m.

IOWA SECTION—Annual meeting at the Fort Des Moines Hotel on November 12 and 16, at 3 p.m. and 6:30 p.m.

KANSAS CITY SECTION—Ladies dinner meeting at the Muehlbach Hotel on November 14, at 7 p.m.

LOS ANGELES SECTION—Dinner meeting at the University Club on November 14, at 6:45 p.m.

MARYLAND SECTION—Dinner meeting at the Engineers' Club on November 15, at 6 p.m. Cocktails; dinner 7 p.m.; meeting 8 p.m.

METROPOLITAN SECTION—Technical meeting in the Engineering Societies Building on November 21, at 8 p.m.

NEW MEXICO SECTION—Technical meeting in La Fonda Hotel on November 7, at 7:30 p.m.

NORTHEASTERN SECTION—Dinner meeting at Northeastern University on November 20, at 6 p.m.

NORTHWESTERN SECTION—Dinner meeting at the Minnesota Union on November 5, at 6:30 p.m.

PHILADELPHIA SECTION—Technical meeting at the Engineers' Club on November 13, at 7:30 p.m.; dinner at 6 p.m.

SACRAMENTO SECTION—Regular luncheon meetings at the Elks Club every Tuesday at 12 m.

SAN FRANCISCO SECTION—Dinner meeting of the Junior Forum at the Engineers' Club on November 22, at 5:45 p.m.

TENNESSEE VALLEY SECTION—Annual meeting at Oak Ridge on November 10.

TEXAS SECTION—Luncheon meeting of the Dallas Branch at the Adolphus Hotel on December 3, at 12:15 p.m.

TRI-CITY SECTION—Annual meeting at the Blackhawk Hotel, Davenport, Iowa, on November 7, at 6:30 p.m.

WEST VIRGINIA SECTION—Meeting at the Fairmont Hotel on November 9, at 3 p.m. and dinner with the West Virginia Society of Professional Engineers at 6:30 p.m.

Recent Activities

CENTRAL OHIO SECTION

At the September 20 meeting of the Section there was considerable discussion of the State-Wide Coordinate Bill, sponsored by the Section and recently passed by the state legislature. The principal speaker was W. H. Rabe, chief design engineer for the Bureau of Bridges, Ohio State Highway Department. Mr. Rabe's subject, "A New Pile Driving Formula," elicited considerable discussion from the floor. During the evening it was announced that the Section's Committee on Postwar Construction is cooperating with the Columbus Chamber of Commerce and the Committee for Economic Development in making a survey of postwar projects proposed for industry, home construction, and political subdivisions.

CINCINNATI SECTION

Guest of honor and principal speaker at the first regular meeting of the new season, held on October 2, was Sherwood L. Reeder. Developing the subject, "The Real Dope About Planning," Mr. Reeder outlined the many features that must be considered when planning for a metropolitan area. He is director of master planning for the local city planning commission.

COLORADO SECTION

Speakers from the U.S. Bureau of Reclamation presented the technical program at the September 10 meeting of the Colorado Section. The first of these speakers was H. S. Meissner, civil engineer in the Materials Laboratory, who described instances of the expansion of concrete, caused by reaction of the alkali in the cement with the silicon dioxide of the aggregate, and the consequent formation of cracks all through the concrete and gel on its surface. Dr. Richard C. Mielenz then discussed "Reactive Aggregates and Their Recognition," showing how experiments with various reactive minerals reveal that the more common ones have low reactivity. In conclusion, Dr. Duncan McConnell gave a more detailed report on the process of expansion, using slides to illustrate the appearance of the deteriorated concrete.

CONNECTICUT SECTION

On September 26 there was a dinner meeting of the Connecticut Section in Hartford. On this occasion the guest of honor and principal speaker was Norris W. Ford, executive vice-president of the Manufacturers' Association of Connecticut, who outlined the postwar plans of Connecticut industry and discussed some of the problems and opportunities faced by management at the present time. Mr. Ford's outlook was decidedly optimistic and gave the group confidence that the serious problems confronting industry can be solved to the advantage of the entire state.

DAYTON SECTION

The Dayton Section inaugurated its fall season with a meeting on September 17, at which J. B. Haverstick was the chief speaker. Mr. Haverstick, who is vice-president of the National Association of Home Builders, explained many of the new devices now being developed that will add to the comfort of the home. The demand for new houses, he pointed out, is greater now than at any other period in our history. An enthusiastic discussion followed his talk.

FLORIDA SECTION

A talk on the proposed Tampa Bay Bridge (from Maximo Point, near St. Petersburg, to Snead Island, near Bradenton) comprised the technical program at the September meeting of the Florida Section. This was given by Freeman H. Horton, member of the architectural engineering firm of Bail and Horton, in charge of the design of the project. The entire structure, including causeway trestle and bridges, is over 12 miles long. The structure crossing the main ship channel will be 12,176 ft in length, with a clear span 600 ft wide by 135 ft high.

ITHACA SECTION

The September dinner meeting of the Section was held in Ithaca on the 20th. Following a business session, W. B. Wilkinson gave a talk on the technical aspects of "The Salt Industry in America." He is connected with the Cayuga Rock Salt Company.

LOS ANGELES SECTION

The list of guests at the September meeting of the Section included A. M. Rawn, former Director of the Society, and Secretary William N. Carey. The latter discussed the activities of the Society, emphasizing their relationship to the individual member and to engineers in general. Following Colonel Carey's talk, the main speaker of the evening—R. W. F. Schmidt, director of airports for the Civil Aeronautics Administration at Santa Monica, Calif.—was introduced. Mr. Schmidt spoke entertainingly and to the point on the subject of engineers in airport construction, pointing out that often large sums of money are spent unnecessarily because of unwarranted precision in the design of the many appurtenances involved in such construction.

The Junior Forum met on September 12 to hear Hugo H. Winter, street design engineer for the City of Los Angeles, discuss the parkway system for the Los Angeles Metropolitan Area. In his talk, which covered the history of parkway construction in Los Angeles, Mr. Winter stressed the peculiarities of the Los Angeles transportation system, pointing out that because of the low population density and large area to be served rail transportation has not been considered suitable to the area. For this reason the tendency has been to develop parkways and use bus transportation.

LOUISIANA SECTION

Members of the Louisiana post of the American Society of Military Engineers were guests of the Louisiana Section at a regular meeting held on September 24. The feature of the occasion was an illustrated lecture on military construction in Alaska. This was presented by Col. Fisher S. Blinn, district engineer for the U.S. Engineer Office at New Orleans.

MARYLAND SECTION

On September 27 members of the Maryland Section gathered for a dinner meeting. During the business session President Digges spoke briefly on the status of postwar construction work in Maryland and of the Section's cooperation with the Maryland Committee on Economic Development. The scheduled speaker was Frank Beirne, one of the editors of the Baltimore *Evening Sun*, who kept the group entertained by a lecture on Baltimore during the War of 1812. Slides were used to illustrate his talk, which reflected an intensive study of the history of the city.

NEW MEXICO SECTION

Much of the September meeting of the Section—held in Santa Fe on the 19th—was given over to a discussion of a proposed mapping program for the state. The program is sponsored by many interested federal agencies, and has as one of its objectives the utilization of experienced personnel now being released by the Army. Because of the small attendance it was decided that the Section should defer any commitments until a later session. The meeting was then turned over to A. R. Long, meteorologist in charge of the Albuquerque office of the U.S. Weather Bureau, who showed an interesting film on the significance of clouds in weather forecasting.

NORTHWESTERN SECTION

A discussion of current plans for developing the water resources of the Missouri Valley constituted the technical program at the October 1 meeting of the Northwestern Section. The principal speaker appearing on the program was George E. Loughland, assistant to the vice-president in charge of operations for the Northern State Power Company, of Minneapolis, who covered irrigation, flood control, power development, navigation, municipal water supply, recreation, and the restoration of former lakes.

OKLAHOMA SECTION

Plans for establishing a George T. Seabury Memorial were presented at the September meeting of the Oklahoma Section, held at Tulsa on the 8th. Details are given elsewhere in the "Society Affairs" section of this issue. The technical program consisted of a talk by Col. Francis J. Wilson, district engineer for the U.S. Engineer Office at Tulsa. Colonel Wilson's paper was entitled "The Proposed Plan of the U.S. Corps of Engineers for Development of the Arkansas River and Its Tributaries."

PANAMA SECTION

There was a joint session of the Section and the Canal Zone post of the Society of American Military Engineers on October 1. On this occasion Fred G. Whaler related some of his experiences in fishing in Pacific waters. Mr. Whaler has lived on the Isthmus for many years, and his fishing trips have ranged from Peru to California and include twelve trips to the Galapagos Islands. He has made a hobby of studying the various species of Pacific Ocean game fish and also the influence of ocean currents on fishing conditions. His talk was considered very timely in view of the prospective resumption of local fishing activities that were almost completely suspended during the war.

PITTSBURGH SECTION

The Pittsburgh Section joined with the local branch of the American Institute of Electrical Engineers and the civil and electrical sections of the Engineers' Society of Western Pennsylvania for its October 9 meeting. The group heard C. N. Phillips, head of the research department for Ebasco Services, Inc., of New York City, speak on "The Principles of Flood Control and Multi-Purpose Dams." Reviewing the fundamentals of flood control, Mr. Phillips stated that, in his opinion, multi-purpose projects are not the cure-all for floods they are popularly supposed to be and demonstrated that on such projects both purposes are usually impaired.

SACRAMENTO SECTION

At its September 4 meeting, the Sacramento Section heard one of its own members, O. J. Todd, give an account of his engineering experiences in China, together with an interpretation of present-day happenings in that country. Mr. Todd was for many years a resident of China. On September 18, V. B. Stanbery presented a talk on "Timing Public Works," pointing out that they should be "timed" in order to get the maximum indirect benefits from their construction, particularly in the matter of helping to level out the business cycle and the employment curve. Mr. Stanbery is on the staff of the California Reconstruction and Reemployment Commission. High light of the program presented on September 25 was a talk by Sgt. Dan Illerich, son of Section Member O. T. Illerich, who described his experiences being rescued by the natives of Borneo after being shot down on a bombing mission.

TOLEDO SECTION

A talk on collective bargaining comprised the technical program at the first fall meeting of the Section, which took place on September 12. This was given by Society Director Frank C. Tolles, who gave a brief history of the various labor acts, with special emphasis on the Wagner Act. A few instances were cited of engineering employees being forced to join one of the labor unions, with no distinction between professionals and non-professionals.

TRI-CITY SECTION

On September 13 members of the Tri-City Section were entertained at a smoker at the Blackhawk Hotel in Davenport, Iowa. A talk on the automatic bomber pilot, used on Army planes, was the feature of the occasion. This was presented by R. A. Baker, of the Minneapolis-Honeywell Regulator Company, who concluded the program by showing three technicolor sound films, made by the Disney Studios, that illustrated the principles of electronics as used in the automatic pilots.

WEST VIRGINIA SECTION

The fall meeting of the West Virginia Section was held at Bluefield on September 8. Members of the Section and their guests met in the afternoon for an inspection trip at the Appalachian Electric Power Company Building, where they were welcomed by L. W. Bates, assistant district manager of the Bluefield Division. A. L. Wellford, Jr., division engineer, then read an illustrated paper describing the company's plant at Glen Lyn, Va., to which the group was then taken on a conducted tour. Members of the Southeast Chapter of the West Virginia Society of Professional Engineers were guests of the Section on the trip and at the dinner that followed. The principal after-dinner speaker was William R. Glidden, bridge engineer for the Virginia Department of Highways, whose subject was "Immediate Postwar Problems for Civil Engineers." O. G. Crow, president of the Southeast Chapter of the West Virginia Society of Professional Engineers, also spoke briefly, as did Lt. Comdr. G. T. Lowe, of the U.S. Naval Reserve, who has just returned after four years of active duty. During the evening it was announced that the new officers elected for 1946 are Ralph N. Shepard, for president, and John B. Hoke, for vice-president. J. N. Wallace continues as secretary-treasurer.

WISCONSIN SECTION

The annual Ladies' Night was celebrated in Milwaukee on September 20. Following dinner and an exchange of greetings, the speaker of the evening—Hugh L. Riordan, professor of economics at Marquette University—was introduced. Professor Riordan's subject, "How Would You Run This World Show Until 2007?," was based on his three-year teaching experience in Japan and on subsequent trips around the world taken for pleasure and study. Outlining the background of our world political structure, Professor Riordan pointed out the position of England in world peace and recommended cooperation with that country as one of the best possible means of guaranteeing our own security.

Student Chapter Annual Reports

Abstracts of Reports as Provided by the Society's Committee on Student Chapters, Covering Roughly the Year 1944. Other Abstracts Will Appear in the December Issue

Editor's Note: Though many of the Student Chapters were able to continue their activities during the war, others were forced to curtail drastically and some to assume an inactive status for the duration. Thus the Annual Reports have been slow in coming in, and there are fewer than in pre-war years.

University of South Carolina

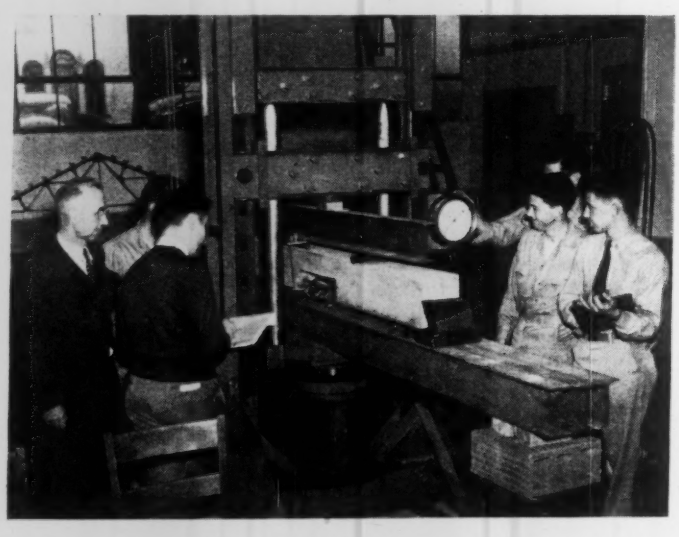
Due to the fact that the majority of members were V-12 trainees, the activities of the Student Chapter were necessarily limited. Nevertheless, 24 meetings were held during 1944. Inspection trips were impossible because of Navy restrictions and transportation difficulties. However, several representatives of the Chapter attended the annual meeting of the South Carolina Section. There was a banquet in honor of the departing seniors, at which time Junior membership dues were awarded by the Section to the senior voted by the Chapter "most likely to succeed in engineering."

University of Southern California

"The Student Chapter at the University of Southern California has just completed a banner year. During the year it not only doubled its membership, thus becoming the fastest growing technical society at the university, but also one of the largest. The reason for this exceptional growth is the technical growth that the Society affords its members. The programs were informative and entertaining. Through the Society we were privileged to receive lantern lecture slides on many varied engineering projects."

At other meetings there were outside speakers, including William F. Axtman, assistant district maintenance engineer, California Division of Highways; A. D. Griffin, assistant district engineer, State of California; Prof. George Bauwens, who is in charge of the surveying department at the university; and Prof. H. J. Miles, of the civil engineering department. Under the supervision of Professor Miles the group visited the above plant and also inspected the Covina (Calif.) Sewage Disposal Plant.

"As guests of the Los Angeles Section, we inspected the Cooperative Wind Tunnel in Pasadena. We had an average representative attendance of 20 students at the regular monthly meetings of the Los Angeles Section. Thus we came in personal contact with the leaders of our chosen profession, and had an opportunity to hear many outstanding speakers."



Student Chapter Members at University of Southern California Testing a Reinforced Concrete Beam

Left to Right: Prof. D. M. Wilson, Don F. Warren, George Thompson, and James Cannon

Alabama Polytechnic Institute

Due to the continuous turn-over of student personnel, the Student Chapter actually had four different sets of officers during 1944. One secretary left for the service on just an hour's notice. In spite of such confusing conditions, an active Chapter was maintained. There were 9 meetings held during the year—several of them jointly with the local branch of the American Society of Mechanical Engineers. All the meetings were attended by the Faculty Adviser.

Georgia School of Technology

Due to the presence of a Navy V-12 unit, the Student Chapter had a banner year in 1944, with enrolment over that of a normal year. This gain in membership made possible not only additions to technical training but also several enjoyable social affairs. The Georgia Section has been most cooperative, and student members have been guests at many of the functions of the Section. Funds for a departmental memorial library were donated to the Chapter by the estate of the late W. A. Hansell, a distinguished alumnus of the school.

Oklahoma Agricultural and Mechanical College

The Chapter was inactive until September 1944, when an increase in enrolment and student interest made a revival of the Chapter possible. Between this date and the end of the year four well-attended meetings were held. One of these was given over to a smoker, at which the advantages of Student Chapter membership were explained. At two other meetings, illustrated lecture material from the Society was used. It is believed that the Chapter is permanently back on its feet.

University of Louisville

At the 14 meetings held during the year, student speakers presented the illustrated lectures made available by the Society. The high light of the year was a trip to Lexington, Ky., for the annual banquet given jointly by the Kentucky Section, the University of Louisville, and the University of Kentucky. At this meeting, three students from each of the two schools contended for three prizes awarded for preparation and delivery of student engineering papers. There were, also, two interesting inspection trips—one to a cement plant and the other to inspect a sand and gravel producer and ready-mixed concrete plant.

Virginia Polytechnic Institute

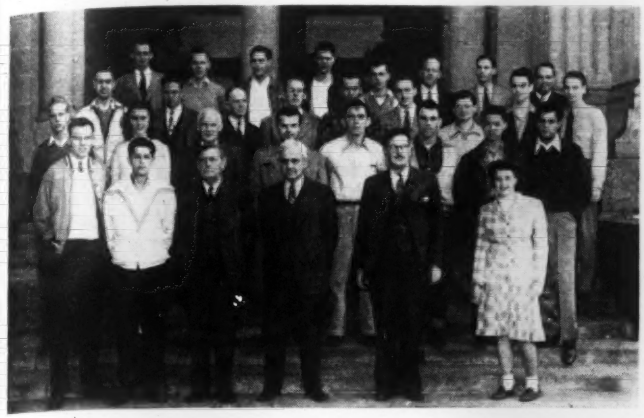
During the calendar year there were 22 meetings. As with so many Student Chapters, there was a constant turn-over of members and officers due to the call of war. During the year freshman civil engineering students were made eligible for Student Chapter membership. The Chapter was well represented at the Roanoke meeting of the Virginia Section, and the Section sponsored an interesting trip through the plant of the Virginia Bridge Company, at Roanoke.

University of Arkansas

Its engineering student personnel greatly reduced by the war, this university has followed, since June 1944, the sound policy of joint meetings of the student chapters of the American Society of Civil Engineers, the American Institute of Electrical Engineers, and the American Society of Mechanical Engineers. These meetings are organized by a committee composed of one member from each Student Chapter. Meetings are held as seminars, the program consisting of an engineering paper and a current event or other planned topic of discussion. Meetings have been very successful, and other schools with reduced enrolment might well consider this system.

STANFORD UNIVERSITY

The Student Chapter at Stanford enjoyed a very successful year in spite of the fact that the A.S.T.P. was abandoned at the end of March, resulting in the loss of some twenty members. Faculty Adviser Prof. Leon B. Reynolds reports on the activities of the year as follows:



MEMBERS OF THE STANFORD UNIVERSITY STUDENT CHAPTER

"...The Stanford Chapter is proud that it was the first one ever organized and is determined to be the last one to go on inactive status. The Chapter therefore decided to admit any engineering student, including freshmen and sophomores, who desired to join, thus abandoning its former plan of admitting only juniors, seniors, and graduate students. . . .

"During the college year members of the civil engineering faculty often serve as hosts and provide the refreshments. It has become a tradition that the last meeting in June is a barbecue in Professor-Emeritus Moser's yard, and that the Chapter invites the faculty and their wives and any wives of student members and furnishes and serves the supper. The speaker last June was Past-President Frederick H. Fowler, which in newspaper parlance might be termed a 'scoop.'

"The Chapter held social meetings monthly during the year; practicing engineers were the speakers. The Contact Member and Junior Contact Member have always attended unless they were out of town, and have been helpful and cooperative. The officers have sought my advice freely and I have tried to guide without being officious. Due to gasoline and tire rationing the attendance at meetings of the San Francisco Section has required a 30-mile trip by train, which has somewhat decreased student attendance. . . ."

UNIVERSITY OF ALABAMA

In spite of a student turn-over every three months, an active Chapter was maintained at the University of Alabama through 1944. There was a total of twelve meetings, all of which were attended by the Faculty Adviser, while one meeting was attended by the Contact Member. This 100% attendance indicates that we have an active Faculty Adviser of whom any Chapter might be proud.

DUKE UNIVERSITY

Since membership in the Chapter was drawn from students assigned by the Navy to engineering at Duke under the V-12 program, there was a constant turn-over of both officers and members. In spite of these difficulties, 13 meetings were held during the year, and the papers delivered covered a wide range of subjects. Regardless of difficulties, an excellent spirit was shown by the members of the Chapter.

SOUTHERN METHODIST UNIVERSITY

At Southern Methodist University the Student Chapter appointed a program committee for each term, which arranged a well-balanced program of student papers, moving pictures, visiting speakers, and special meetings. The senior members of the Chapter have been attending the monthly meetings of the Dallas Section, which they have found most enjoyable. The Chapter is particularly grateful to the Section for furnishing speakers for Chapter meetings and for their invitation to attend the Section meetings. During the past year the Student Chapter members made a number of interesting and educational field trips, to the many large projects that are under construction in and near Dallas.

In an effort to comply with the regulations of the Office of Defense Transportation only one trip of any length was taken—to Denison Dam on the Red River, the world's largest rolled fill earth dam. Several members of the Denison District of the U.S. Corps of Engineers took the party on an inspection trip over the project, explaining the details of construction.

UNIVERSITY OF COLORADO

The Student Chapter at the University of Colorado reports a year of full activity. The College of Engineering, operating under a V-12 program, had from 60 to 100 civil engineering students. Approximately 82% of those eligible were members of the Chapter and participated in its activities. There was a total of 18 regular meetings during the year, with an average of 61 in attendance. A well-diversified program was presented, maintaining a good balance between technical speakers, sound color movies, and dinner meetings. Gasoline rationing forced the eliminating of inspection trips from the program.

The Colorado Section of the Society, which meets in Denver every month, has always welcomed members of the Student Chapter and the May meeting each year is designated as Student Chapter Night. All of the seniors and many of the juniors attend this meeting. In addition, several of the seniors attend the Section's monthly meetings.

During the year 26 Student Chapter members applied for Junior membership in the Society. This number includes every graduate from the civil engineering department, except one man who was too old to qualify.

UNIVERSITY OF CALIFORNIA

The University of California Chapter reports that the year 1943-1944 has been an important one in its history, showing that even under the pressure of an accelerated academic schedule and a decrease in enrolment the Chapter has been able to carry on actively.

"A fundamental purpose of the Chapter is to aid the graduating student in obtaining a position in the field in which he wishes to work. To act as a connecting link between the Chapter and the civil engineering profession the Chapter elects as Contact Members two men who are active engineers and who show an interest in student affairs.

"For any organization to function efficiently, its activities must be publicized. The Chapter has two channels of publicity. The first of these is *Civil Cal*, a monthly paper edited by some members of the Chapter. This paper reaches all the members of the Chapter and keeps them informed as to the past and future activities of the Chapter. The second medium of publicity is the *Cal Engineer*, a magazine published monthly by the Associated Students of the University of California and distributed throughout the campus. A section of this magazine is reserved for news of the different engineering associations, and it is in this section that the activities of the Chapter are published."

Faculty Adviser Prof. Clement T. Wiskocil reports: "The participation of our members in general campus activities maintains the name of the civil engineer in a prominent and dignified position. For example, one of our senior Student Chapter members has just been elected student body president. This is quite remarkable, considering that our civil engineering enrolment has dropped to only 107 of the campus total of 7,000."

GROUP FROM THE UNIVERSITY OF CALIFORNIA CHAPTER

ITEMS OF INTEREST

About Engineers and Engineering

RUSSIAN GULCH BRIDGE WITH ARCH CENTERING STILL IN PLACE

Simplicity Marks Esthetic California Bridge

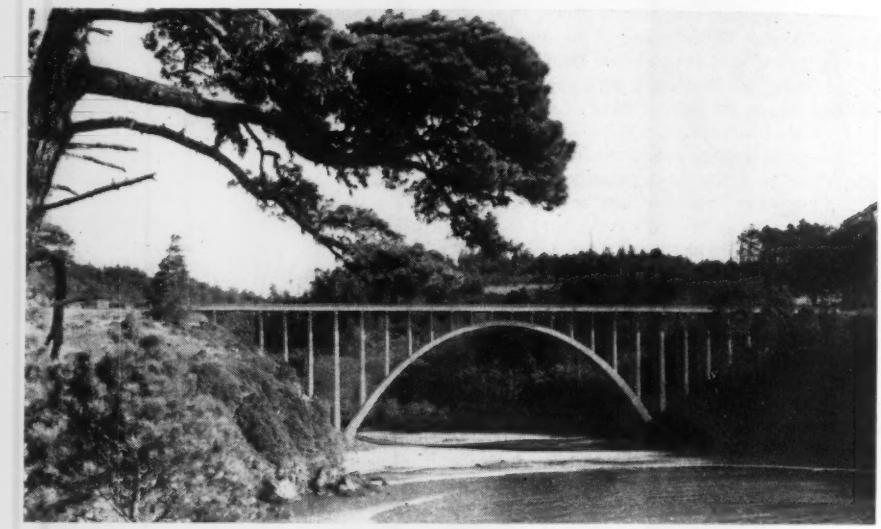
By HENRY E. KUPHAL

ASSOCIATE BRIDGE ENGINEER, CALIFORNIA DIVISION OF HIGHWAYS

CROSSING ONE of the many deep indentations on the Coast of Mendocino County in Northern California, the Russian Gulch Bridge is directly adjacent to the ocean. It is within the limits of a park, one of a number of places of natural beauty set aside by the State of California for recreational purposes. The Park Commission requested the Bridge Department to build an artistic-looking bridge, one that would harmonize with the natural beauty of its surroundings. It was not to be ornate. Simplicity was the keynote, for the less the eye is diverted from the harmony of the whole, the more pleasing the effect.

As constructed, the bridge is a rather high-rise, open spandrel arch with a span of 240 ft, a rise of 85 ft, and approach spans of 122 and 164 ft. The rise ratio used produces a rib with a graceful rainbow-like curve, ending in a thickening at the base of the rib, like a tree springing from the ground, rather than in massive abutments. It is without the conventional heavy end spandrel columns which, by dividing the arch span from the approaches, require the onlooker to view at least three distinct bridges rather than simply one.

The deck was built as a series of continuous slab spans, rather than the conventional slab-and-girder type. The thickness of the slabs was varied so that the main longitudinal reinforcing could be placed at the same spacing in all spans, with a minimum variation in bar sizes. Slab bars were lapped at points of maximum stress, thus using the value of both bars and eliminating the usual splices. An edge beam with a constant depth of 18 in. was placed along slab edges for strength, as well as to prevent the unsightliness of unequal deck thicknesses.



VIEW OF COMPLETED RUSSIAN GULCH BRIDGE FROM THE OCEAN SIDE

There is variation in the spacing of the spandrels as well as in the thickness of the columns. At the arch crown the spandrels are spaced on 16-ft centers; this distance gradually increases to 20 ft at the rib ends and again diminishes toward the ends of the approaches. The column thickness at the top varies correspondingly—from 1 ft 6 in. to 2 ft, with a slight batter of 1 in 96 on each side. These variations are not noticeable when the bridge is viewed as a whole, as they merely tend to neutralize the exaggerated effect produced by the extreme differences in the heights of the bents, one variation counteracting the other.

The rib was laid out as one elliptical segment, fitting the dead-load polygon, using a single curve rather than a multitude of circular segments. A single smooth curve always is more graceful, since the eye unconsciously feels the difference when the curve is built up of a series of circular arcs.

This type of arch rib was originated by the writer and has been used by the California Bridge Department for about ten years. A single curve with a parabolic type of thickness variation lends itself to integration. Tables of ordinates and redundants for producing influence lines have been prepared, making the laying out of the rib and subsequent stress analysis a rather simple matter. The cost per square foot was less than that for any other type estimated, demonstrating the fact that grace and beauty can be attained without excessive cost, and a structure produced that will evoke praise from all who see it.

An Index to Microfilms of Documentary Photographs

FOR years the Library of Congress has had important collections of photographs in its custody, and steps are now being taken to make them better known and more easily and widely available with the issue of a subject index to one of its great collections. Included in the collection indexed is the photographic survey of the American people made between 1935 and 1943 by a staff of famous photographers working under the direction of Roy E. Stryker, first under the sponsorship of the Farm Security Administration and later under that of the Office of War Information.

The "Index of Microfilms, series A, Lots 1-1737," a mimeographed, double-column, subject index of 26 pages serves as an aid to purchasing films, or to finding the lot desired for viewing. It may also be used, even without the microfilms, to determine the general scope of the first part of the collection to be organized. The Index is available upon application to the Information and Publications Office, The Library of Congress, Washington 25, D.C.

A.I.E.E. Report on Collective Bargaining

Prepared by Committee of American Institute of Electrical Engineers and Reprinted from "Electrical Engineering" for July 1945

For over two years the Society has been active in the field of collective bargaining. Other engineering organizations have also studied the matter and some have issued official reports. One of the latter is that of the American Institute of Electrical Engineers here reproduced. It appeared originally in the July 1945 issue of the Institute's journal, "Electrical Engineering." A joint committee of Engineers Joint Council has been operating since the summer of 1944. It commends the present report for analytical study and urges that comments be submitted to the Secretary of the Electrical Engineers' Committee, E. P. Yerkes, The Bell Telephone Company of Pennsylvania, 1835 Arch Street, Philadelphia, Pa.; with copy to Society Headquarters, 33 West 39th Street, New York 18, N.Y.

THE LAST 15 years have witnessed substantial changes in employee–employer relationships. Of the many forces that have accounted for these changes, the most important are

1. The great depression which developed a strong urge for security on the part of wage earners.
2. Social legislation designed to bring about a better distribution of national income and to provide greater security for workers through the establishment of minimum labor standards, various types of social insurances, as well as by the encouragement of labor organizations and collective bargaining.
3. The growth in the membership and power of organized labor, especially in the mass-production industries.
4. The split in the American labor movement.
5. The shortage of manpower occasioned by World War II and the controls introduced by unions and the Federal Government affecting this shortage.

Until very recent years the great majority of employees have dealt as individuals with their employers in establishing wages, hours, and conditions of employment. In 1929—one of our most prosperous peacetime years—the membership of organized labor totaled approximately 3,500,000 workers. As the depression set in, union membership slowly but steadily declined to under 3,000,000. In 1933 the labor movement surged forward aided by improved business conditions but more especially by the National Industrial Recovery Act and later by the National Labor Relations Act and the policies carried out by the National Labor Relations Board and by the National War Labor Board. Today labor organizations, according to various estimates, have a membership of between 12,000,000 and 13,000,000, and the wage contracts negotiated by them probably apply to an additional 3,000,000 or 4,000,000.

The character of the American labor movement has undergone considerable change during these years. This change has been accentuated by the existence of two competing national federations (the American Federation of Labor and the Congress of Industrial Organizations), the United Mine Workers of America, and the Confederated Unions of America. The last-mentioned organization is an association of independent unions. To retain or to win leadership in the field, each of these organizations has found it necessary to expand its jurisdiction and increase its membership. The movement, which had been largely one of production workers, rapidly spread to clerical employees. Later the drive was broadened to include professional employees.

It was the pressure to bring engineers into heterogeneous unions comprising professional and non-professional employees which are affiliated with the A. F. of L. or the C.I.O. that led to the appointment of the American Institute of Electrical Engineers (A.I.E.E.) committee on collective bargaining and related matters.

STATEMENT OF THE PROBLEM

To clarify its own thinking, the committee has defined the problem which the Institute has placed before it as follows:

Should the American Institute of Electrical Engineers take any action with respect to the determined efforts of unions of professional and non-professional workers to organize and sometimes to compel professional employees, including electrical engineers, to join their associations for collective bargaining, mutual aid, and other purposes? If so, what action should be taken?"

The National Labor Relations Act guarantees employees the right to organize and bargain collectively and forbids employers to interfere with self-organization or to refuse to bargain with certified groups of employees. There always will be some employers who, unless restrained, will disregard the rights and legitimate wants of their workers, and severe competition within industry may occasion reductions in labor standards which progressive and socially minded employers deplore. Also drastic curtailments in business activity give rise to unemployment, loss of earnings and sometimes unfair terms and conditions of work. It is for these and other reasons that employees have been guaranteed protection in the exercise of their rights to form unions and to negotiate wage contracts. The voluntary exercise of these rights cannot be denied in a free society. However, the National Labor Relations Act does not compel anyone to join a union. On the other hand, the Act does not prevent employers and employees from entering into closed-shop or union-shop agreements which, as a condition of employment, require membership in a particular union.

Many engineers believe that the inclusion of professional employees in an organization of both professional and non-professional employees in which the non-professional workers constitute the majority would not give engineers adequate protection, inasmuch as their wages and conditions would be negotiated by leaders elected and maintained in power by non-professional workers whose interests would have to come first and whose demands might be satisfied at the expense of the professional employees. The interests of non-professional employees and of professional employees in many respects are not similar. Because of their education and training, and their genuine concern with the effective utilization of labor, materials, machines, and natural forces, as well as their obligations under their codes of professional conduct, the engineers may prefer to unite to formulate their own objectives, policies, and methods and to negotiate their wages and terms of employment.

The committee is of the opinion that the Institute should make it a matter of record that it is not opposed to labor organizations or to collective bargaining, so long as the goals of labor organizations do not run contrary to the law or conflict with the best interests of the engineering profession. It believes that the professional engineering societies should have but one concern with labor organizations or unions, namely, to see that professional employees are not compelled to join labor organizations, especially when such organizations are dominated or controlled by non-professional employees, and are not forced into bargaining units dominated or controlled by non-professional employees.

The law does not require anyone to join a labor organization. Direct compulsion may occur in only one way, namely, when a union-shop or closed-shop contract is put into effect. (For definition of various types of union-security arrangements see Appendix I.) The foregoing types of union-employer relationships in the great majority of cases are established through collective bargaining. In only one case has a federal agency been willing to urge the closed or union shop on an employer, and that was in June 1941, when the National

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A report prepared by the A.I.E.E. committee on collective bargaining and related matters: I. Melville Stein, *chairman*; E. P. Yerkes, *secretary*; O. W. Eshbach; W. R. Hough; A. C. Streamer; and B. Van Ness, Jr.

The A.I.E.E. committee on collective bargaining and related matters was very fortunate in obtaining the consulting services of Waldo E. Fisher, professor of industrial relations at the Wharton School, University of Pennsylvania. A student of industrial relations for over a quarter of a century and author of many books, reports, and papers relating to that subject, Doctor Fisher has served government society, and industry in many important assignments of which the following few are representative: consultant to National War Labor Board, member of staff of International Labor Office, past president Philadelphia Industrial Relations Association.

On Doctor Fisher's recommendation and through his cooperation, the committee has conferred with William M. Leiserson. In introducing a recent article by Doctor Leiserson in *The American Magazine*, the editor made the following statement: "Doctor Leiserson has perhaps the most impartial and comprehensive view of labor problems of any man in America. In the last 35 years he has served as a mediator and arbitrator of labor disputes in many industries. He has made studies of labor problems for cities, states, and the National Government. In addition to being chairman of the National Mediation Board, he has served as chairman of the National Petroleum Labor Policy Board, member of the National Labor Relations Board, and chairman of the National Railway Labor Panel. He is now visiting professor of economics at Johns Hopkins University."

Defense Mediation Board recommended, with but one dissenting vote, that the Bethlehem Steel Corporation accept a master agreement providing for a closed shop which had been submitted to the company by the union representatives of the shipbuilding employees on the Pacific Coast. Several months later, the same Board refused to order the steel companies to grant the union shop to the United Mine Workers of America for its members employed in coal mines operated by these companies. The latter decision brought about the Board's demise.

The National Labor Relations Board has no authority under the National Labor Relations Act to order the introduction of a closed or union shop. The National War Labor Board, presumably in return for the no-strike pledge, has ordered maintenance-of-membership clauses to be embodied in wage contracts and has ordered the renewal of a closed- or union-shop clause during the negotiation of a new contract. It has not, however, ordered the adoption of either a closed or a union shop where these types were not in effect in the expiring contract.

Under closed-shop or union-shop contracts covering all employees in the bargaining unit, professional employees with no supervisory responsibilities could be compelled to join a labor organization which might be dominated by non-professional employees. Such compulsion could happen under maintenance-of-membership contracts, only if professional employees were members of the labor organization and failed to exercise their option to resign during the 15-day period set aside for this purpose.

Indirect compulsion, however, may occur in other ways. Professional employees may be forced into unions of non-professional workers by pressure applied by union members. Redress from physical force and threats does not fall within the jurisdiction of the National Labor Relations Board but is a matter that must be taken up with the courts. Also, indirect compulsion takes place when the National Labor Relations Board makes a decision which, because of the absence of a qualified group of professional employees, brings professional employees into a bargaining unit composed primarily of non-professional employees. In this case there is direct compulsion with reference to placing professional employees in a *bargaining unit* composed primarily of non-professional employees, but there is no direct compulsion to join the *organization* of non-professional employees which is recognized as the *bargaining agent*. However, to avoid ill feeling between the professional employees and their bargaining agent and to take advantage of the only opportunity to be represented in the negotiations covering the terms of their employment, the professional employees might find it necessary to join the organization controlled by non-professional employees.

To protect themselves against either direct or indirect compulsion, engineers may find that their best defense is an organization either of engineering employees, or of engineering and other professional employees, associated with or independent of a national federation of labor.

It is the committee's considered opinion that engineers, guided by their personal convictions and the circumstances in which they find themselves, should decide for themselves whether they wish:

1. To join a union associated with one of the national federations of labor which may be either a union of professional employees only or a union of both professional and non-professional employees.
2. To join with other professional employees for the purpose of forming an independent organization composed exclusively of engineers or of engineers and other professional employees.
3. To refrain from joining any labor organization.

Except in cases involving closed-shop or union-shop contracts, the engineer's right to make his own choice is guaranteed by the National Labor Relations Act.

The committee believes that electrical engineers should be fully informed as to their rights and opportunities under the National Labor Relations Act but that their choice of a bargaining agency should not be influenced by the Institute, beyond its indicating to them that, in the interest of their professional status, it would be undesirable for them to belong to, or to be represented by, a labor organization dominated or controlled by non-professional employees.

Possible Courses of Action to Be Taken by the Institute

Five courses of action suggest themselves to the committee. The Institute may:

1. Do nothing.
2. Study the situation and prepare a manual for the individual members, setting forth what the Institute and similar organizations may and may not do and indicating clearly what courses of action are open to individuals or groups.
3. Set up machinery within the engineering societies which will enable them to intervene as a friend of the court for the purpose of assisting engineers engaged in engineering work of a professional nature to remain outside of bargaining groups of non-professional men, or to exercise their right to bargain collectively through representatives of their own choosing.
4. Attempt to set up professional organizations through the Institute or its Sections, as collective-bargaining agencies for professional men.
5. Attempt to secure a modification of the Wagner Act which would either:
   (*a*) Exempt engineers from the provisions of the Act, or
   (*b*) Put professional employees in a separate category under the Act.

The committee believes that the A.I.E.E would fall short of fulfilling its obligations to its members if it were to do nothing at all. While the Institute is interested primarily in increasing scientific and technical knowledge in the field of engineering, it cannot ignore the impact of political and social changes in our national economy upon the engineering profession. The recent developments in the field of industrial relations fall into this category.

The committee also believes that some action is necessary to ensure the maintenance of a high professional standing among engineers in conformance with the objectives stated in the A.I.E.E. constitution:

> Its objects shall be the advancement of the theory and practice of electrical engineering and of the allied arts and sciences and the maintenance of a high professional standing among its members.

On the other hand, the course of action listed as 5(*a*) has little to offer as a solution of the problem facing engineers. Those close to the situation in Washington hold that efforts to exempt engineers from the provisions of the National Labor Relations Act have very little chance of success. The Act applies to all employees including doctors, lawyers, and other professional employees, working in establishments engaged in or affecting interstate commerce. It would be difficult to justify exemption for engineers as a group, especially since many engineers undoubtedly would protest such action. It also has been pointed out that, even if this objective could be achieved, the problem would still remain. Unions could and probably would accept engineers as members and nothing in the National Labor Relations Act would preclude such action, even if engineers were excluded from the provisions of the Act. Moreover, in those instances in which engineers believe they need a labor organization to protect their interests and the employer refuses recognition, the bargaining agency for the engineers would have to resort to strikes to obtain a wage contract, since the exclusion of engineers from the National Labor Relations Act would not permit certification by means of an election under the supervision of the National Labor Relations Board. The engineers would be in exactly the same position in which the foremen found themselves prior to a recent decision.* When the National Labor Relations Board held that it would not establish a bargaining unit for foremen and would not certify bargaining representatives for them, a wave of foremen's strikes spread throughout industry. As a result foremen through their organization, the Foremen's Association of America, have secured recognition and union agreement in certain establishments. To clarify the situation, the National Labor Relations Board found it necessary to hold a hearing in Detroit in December 1944 for the purpose of reconsidering its position on the foremen question and of deciding whether they were entitled to all the rights that other employees enjoy under the National Labor Relations Act. Lastly, the fact that engineers now have the right to join unions whenever such a course of action seems desirable gives them, as individuals, a potential bargaining power with their employers which many engineers would not want to surrender.

Through course 5(*b*), instead of attempting to have engineers in professional work excluded from the provisions of the National Labor Relations Act, the attempt might be made to modify the Act so as to place professional employees, including engineers, in a separate category under the Act. Presumably, under such modification professional employees would be considered ineligible for inclusion in bargaining units of non-professional employees but

* On March 26, 1945, in a case involving the Packard Motor Car Company and the Foremen's Association of America, the Board reversed by a two to one vote its Maryland Drydock decision and granted organizations of foremen, which are unaffiliated and independent of other unions, the right to petition the Board and, where they can win an election, to be certified as the legal agent of supervisory employees in a specified bargaining unit.

would still have the right under the Act to be placed in bargaining units of professional employees, if they so desired and to be represented by representatives of their own choosing. In principle, at least, such an arrangement would seem to be better than any proposed to date with reference to modification of the existing law affecting collective bargaining by professional employees. It would avoid having professional employees represented by non-professional employees or by representatives chosen by a group in which non-professional employees predominated, and yet it would not deny professional employees any rights guaranteed to other types of employees.

If requested to do so by a substantial majority of their professional employee members, the engineering societies could quite properly advocate and work for such a modification of the National Labor Relations Act. In doing so they would be following a course similar, in principle, to that sponsored by the American Federation of Labor, which has advocated an amendment to the Act providing for craft bargaining units when requested by employees in particular crafts. Naturally the outcome of such a procedure cannot be predicted, but it seems unlikely that the necessary modification of the Act could be accomplished at an early date, if at all. Meanwhile, professional employees would have no assurance that they would not be represented by representatives chosen by groups dominated or controlled by non-professional employees. In this connection it should be pointed out that, if professional employees, through the formation of, or affiliation with, organizations of professional employees, were assigned by the National Labor Relations Board to bargaining units composed solely or predominantly of professional employees, they would be in a no less favorable position in the event that the above modification of the National Labor Relations Act were accomplished later.

An arrangement similar to that indicated in course of action 5(*b*), but providing for a separate order-in-council and board, recently was advocated in Canada as a substitute for the present Canadian Wartime Labour Relations Act (P.C. 1003) in so far as that Act involves professional employees. The attempt was not successful but did result in a temporary modification of the procedures under the Act which apparently would assure the right of professional employees to be included in bargaining units of professional employees, even though they had been included previously in heterogeneous bargaining units or units of non-professional employees.

Course of action 4 would seem to be undesirable for a number of reasons. The right to bargain collectively is not an abstract right but one to be exercised in terms of specific bargaining units. To enjoy this right employees must form or join organizations which are free from employer domination and control. Section 8 of the Wagner Act specifically states that it shall be an unfair labor practice for an employer:

1. "To interfere with, restrain, or coerce employees in the exercise of the rights guaranteed in Section 7" which reads "employees shall have the right to self-organization, to form, join or assist labor organizations, to bargain collectively through representatives of their own choosing, and to engage in concerted activities, for the purpose of collective bargaining or other mutual aid or protection."

2. "To dominate or interfere with the formation or administration of any labor organization or contribute financial or other support to it . . . ."

The committee believes that any bargaining agency for engineers or professional employees set up by the American Institute of Electrical Engineers or its Sections later might find itself handicapped at subsequent hearings before the National Labor Relations Board. Competing unions undoubtedly would challenge its status as a bona fide bargaining agency, inasmuch as it had come into existence with the help of an association whose membership and more especially its officers and directors include employing engineers and management representatives. Professional labor leaders undoubtedly would try to prove that these agencies were initiated, sponsored, assisted, and indirectly controlled by an association dominated by employers and their representatives and would demand that they be disestablished. Thus these Institute-sponsored bargaining agencies always would be in the position of having to prove to the National Labor Relations Board that they were not employer dominated.

The committee believes it would be a disservice to the individual members as well as the Institute to endorse a procedure which later might be declared to be in violation of the National Labor Relations Act or would hamper engineers in subsequent efforts to exercise their rights under that Act. The committee would like to add that, just as it considers it unwise for non-professional workers to dominate a minority of professional employees, so it believes it equally unwise for the Institute to take any action which might leave the impression that its members who are employers or who occupy official positions with management have any desire to impose their ideas as to organization or collective bargaining on those members of the Institute who happen to be employees.

For this reason and because the committee believes that the creation of labor organizations for collective bargaining is a function which falls outside the field of activity of the Institute, it concludes that the Institute itself or any of its Sections should refrain from sponsoring either directly or indirectly the formation of bargaining agencies for its employee members and from assisting in the formation of such organizations.

The committee believes that course of action 3 should not be followed except under unusual circumstances. It is true that professional organizations have intervened for their members as a friend of the court. It is quite possible that the National Labor Relations Board may continue to listen to their contentions in specific situations. The committee has been advised on good authority that intervention probably would not be granted to professional engineering societies, if the purpose were to help their members to keep out of a particular union or to tell the Board how engineers should be organized. The Board takes the position that a group of employees may organize in any way it sees fit as long as it keeps free from employer domination. It also maintains that elections are held not to determine whether employees want to stay out of a union but to ascertain the wishes of employees concerning a union or several unions seeking certification. Intervention may be justified in certain instances especially where the engineering members of a bona fide organization of professional employees request the Institute to intervene in their behalf. Under such circumstances the Institute would have an interest in the case, because it would be assisting certain employees involved in the case to obtain what to them is a satisfactory bargaining unit. It then could take the position that engineers or professional employees, because of their training, responsibility, nature of work, and so forth, are a homogeneous group for purposes of collective bargaining.

The committee has been informed that engineering associations, unless they can establish an interest in the case, probably would be allowed to intervene as a friend of the court only in very rare instances, such as an occasion when the Board is hearing oral arguments in Washington on the record of a particular case, previously heard in the field by a trial examiner, in which the question before the Board is a difficult one involving considerations of wide public interest. A case in point was the hearing for the purpose of oral argument held in connection with foremen's unions, at which a number of outside organizations were permitted to intervene and file briefs. Thereafter, the foremen's cases were handled like the ordinary run of representation cases.

It should be pointed out that intervention will have little value unless it is undertaken early in the process—certainly before the situation becomes crystallized.

In order to eliminate duplication of effort and conflicting testimony, it may be advisable for the various engineering associations to establish a joint committee which would serve as a clearing house for these associations and to arrange for a common counsel for participating associations in those cases in which intervention is sought. Under such an arrangement each engineering association could elect to intervene in any particular case with the minimum of expense and wasted effort. It would have the additional advantage of reducing to a minimum the confusion and irritation, as far as the National Labor Relations Board is concerned, that undoubtedly would result from independent action on the part of each association. This procedure would enable the Institute: (*a*) to join with other engineering associations, (*b*) to act alone, or (*c*) to refrain from any action, depending upon the issues and circumstances in a given case.

With reference to course of action 2, the committee believes that the preparation of a monograph entitled "Collective Bargaining and the Professional Employee" should be prepared for the information and guidance of members of the A.I.E.E. The

exact nature and specific content of this monograph should be given careful study and be prepared under the direction of a committee of the Institute. It might well include:

1. Statement of the problem facing the professional employee.
2. The American labor movement.
   (*a*) Why it came into being
   (*b*) Its aims and goals
   (*c*) Its structure: various types of local and national unions; the A. F. of L.; the C.I.O.; other important national organizations
   (*d*) Its functions, policies, and tactics
   (*e*) The extent of organization
3. The National Labor Relations Act (Wagner Act).
   (*a*) The rights and responsibilities of professional employees under the Act
4. Collective bargaining.
   (*a*) Function
   (*b*) Subject matter
   (*c*) Techniques
5. Courses of action open to engineers and other professional employees to protect their own interests.

Recommendations

The committee on collective bargaining and related matters recommends that the American Institute of Electrical Engineers adopt the following tentative policy:

1. Prepare a manual for members presenting the essential facts about the American Labor movement and the National Labor Relations Act (Wagner Act) and setting forth (1) what the Institute may and may not do and (2) the courses of action that are open to its members.
2. Seek the establishment of a joint committee composed of representatives of the various engineering societies which would serve as a clearing center for these associations and, in those cases in which two or more societies desire and have the right to intervene as a friend of the court on behalf of their members, make arrangements for a common counsel.

Note. The committee has been informed that the Institute generally will have little opportunity to intervene as a friend of the court in labor cases involving engineers. It believes, however, that such action may be both possible and desirable in certain circumstances. A joint committee would enable each society to join with other engineering societies, to act alone, or to refrain from any action depending upon the issues and circumstances in a given case.

3. Establish a continuing committee on collective bargaining and related matters in order that the Institute may be kept informed about new developments concerning unionization and collective bargaining.
4. Refrain from establishing collective-bargaining agencies for engineers which are directly or indirectly associated with the Institute or its Sections, and from assisting in any way in the actual formation or administration of a labor organization for engineers.

DETERMINING THE BARGAINING UNIT

The National Labor Relations Act guarantees employees the right to self-organization, that is, to form or join organizations and to bargain collectively through representatives of their own choosing. The Board has taken the position that any employee organization has complete freedom to define its membership qualifications as it sees fit, as long as it keeps free of employer domination. In other words, the composition of a labor organization, even though it includes professional workers, foremen, and employers in its membership, is of no concern to the Board, unless the organization is employer minded or employer dominated. Employer-initiated and employer-dominated unions are illegal under the Act and, therefore, have no standing before the Board.

The Board's primary concern in representation disputes is with the character of the bargaining unit. It is important to note that the bargaining unit and the membership of a union need not be coextensive and frequently are not. An employee organization need not bargain for its entire membership or even for any of its members. It may bargain for employees entirely outside of its membership. As a matter of fact, collective bargaining for a particular group of employees may be done by an outside individual, a small committee, a union, or some other association. All that the Act requires is that the representative or representatives be of the employees' own choosing and be free of employer domination.

Many of the disputes before the Board arise over the bargaining unit claimed by the representatives of the union seeking recognition.* In all representation cases the Board is required by law to decide specifically the question as to what bargaining unit is appropriate.†

Where there is only one organization involved and the organization has been designated by approximately 30% of the employees in the bargaining unit, the Board will hold an election and, unless the employing company presents valid objections, certify the organization, should it win the support of the majority of the qualified employees voting. It is where two competing labor organizations claim identical or overlapping jurisdiction that the Board must decide which one shall be the bargaining agent. In doing so the Board's chief aim is to bring together in a single unit those employees who have a community of interest which is likely to further harmonious organization and facilitate the aims of collective bargaining. Conflicting claims, as well as justifications which go back over a period of years, sometimes make the determination of a bargaining unit a difficult task. The Board has found it necessary, therefore, to set up a number of criteria to be used as a guide in the making of a decision. These criteria may be summarized as follows:[1]

1. The history, extent, and type of organization of employees
2. The history of collective bargaining
3. The history, extent, and type of organization of employees in other plants of the same employer, or other employers in the same industry
4. The skill, wages, work, and working conditions of the employees
5. The desires of the employees
6. The eligibility of the employees for membership in the union or unions involved
7. The relationship between the unit or units proposed and the employer's organization, management, and operation
8. Whether an association of separate employers is in existence exercising employer functions, and having a history of collective bargaining on a multiple-employer basis

No precise weight is given to any of the above criteria. Generally several considerations are involved in each case. The Board holds that the complexity of the problem precludes the use of rigid rules in the determination of the unit appropriate for the purposes of collective bargaining.

Considerable weight, however, is given to the desires of employees in representation cases in which rival organizations have advanced conflicting jurisdictional claims. In such situations the Board applies the Globe doctrine—so named because the principle was first enunciated in the case of the Globe Machine and Stamping Company and the Metal Polishers Union, Local Number 3, and others. Under this doctrine the employees are permitted to decide by vote whether they want a separate craft union or desire to be included with other employees in a larger bargaining unit. If the majority of a given craft or related crafts vote for a craft union, the Board rules that the craft shall be the bargaining unit. If the majority vote for the larger bargaining unit, the Board denies separate craft representation. Incidentally, the American Federation of Labor now is advocating an amendment to the Wagner Act which would make this procedure a part of the Act.

DEFINITION OF PROFESSIONAL EMPLOYEE

Because organizations of professional employees seeking certification may find themselves facing competing unions also claiming jurisdiction of salaried employees, a definition of "professional employee" is necessary.* The distinction between "professional status" and "non-professional work" was a subject of controversy in the matter of Shell Development Company,

* The Board also handles complaint cases involving charges of employer violation of the provisions of the Act relating to unfair labor practices. These disputes, however, have no bearing on the issues under discussion.

† See Apendix I for distinction between "bargaining unit" and "bargaining agent."

* A definition of a professional employee helps to define the jurisdiction of a professional-employees' organization and should be an important guide to the N.L.R.B. in determining an appropriate bargaining unit.

Inc., and the International Federation of Architects, Engineers, Chemists, and Technicians, case XX-*R*-552. It well may be an issue in future cases before the Board.

The committee suggests the following definition: A person employed in a bona fide professional capacity is any employee engaged in:

1. Work predominantly intellectual and varied in character, as opposed to routine mental, mechanical, or physical work
2. Work requiring the consistent exercise of discretion and judgment in its performance
3. Work of such a character that the output produced or the result accomplished cannot be standardized in relation to a given period of time
4. Work requiring knowledge of an advanced type in a field of science or learning customarily acquired by a prolonged course of specialized intellectual instruction and study, as distinguished from a general academic education and from an apprenticeship, and from training in the performance of routine mental, manual, or physical processes
5. Work predominantly original and creative in character in a recognized field of technological endeavor involving invention, imagination, or talent
6. Work of a non-professional character when scheduled for students or graduates of accredited colleges or universities as a part of their training and education to acquire a professional status as defined herein
7. Work of a non-professional character performed temporarily as a part of a professional investigation

It should be stated that criteria 1, 2, 3, and 4 have been taken without change from the definition of professional employee as defined by the Wage and Hour Division.[3] Criterion 5 also is taken from this report but in a slightly modified and abbreviated form, while 6 and 7 have been added to meet the requirements of junior engineers who are in the process of attaining a professional status, or engineers who have been assigned temporarily to non-professional work in order to further their research or investigation.

STATUS OF YOUNG ENGINEERS DOING NON-PROFESSIONAL WORK

The Committee has given serious consideration to the status under the National Labor Relations Act of young engineers who may be attending or who have graduated from an accredited engineering school but who, as a part of their training, are working on non-professional jobs. The question is frequently asked—Would young engineers on non-professional jobs be compelled to join organizations of non-professional employees while performing such work, or would they be permitted to join an organization of professional employees if they desired to do so?

In answering this question it should be pointed out that engineers could be compelled to join a labor organization only if a closed or union shop prevails in the bargaining unit in which the engineers are performing non-professional work. The Board does not order employees to become members of labor organizations. Its task is to decide what the bargaining unit shall be in specific situations which are brought before it. In determining the bargaining unit, the Board must decide whether engineers shall or shall not be included.

The action to be taken by the Board probably would vary with the circumstances in each case. If a union and an employer both agreed that young engineers on non-professional work should be included in a particular bargaining unit then the Board as a rule would accept the arrangement. Again, if a union at the request of the employer agreed to exclude such employees, the Board in the absence of any protests probably would accept this disposition of the matter. If a union insisted upon the inclusion of such engineers in a bargaining unit, the Board presumably would apply the criteria listed above and make a decision on the basis of the factors prevailing in a given situation. If young engineers in this category had been members of a bona fide union in the plant or industry for a period of years, the Board undoubtedly would be reluctant to disturb the prevailing arrangement. Where no precedent had been established and a majority of the engineers had refused to sign membership cards but instead insisted upon membership in an association of professional employees, the Board in all likelihood would give careful consideration to their request. In such a situation resort to the Globe doctrine would seem to be the logical course of action.

We may conclude, then, that engineers can be compelled to join a labor organization only where they have been assigned to a particular bargaining unit and a closed or union shop has been established for that unit by voluntary agreement between the union and the employer.

TYPES OF LABOR ORGANIZATIONS OPEN TO ENGINEERS

One of the problems which would have to be faced by engineers is the selection of the type of labor organization which they would wish to represent them when some form of organized representation becomes desirable. A number of possibilities present themselves. Each of the types of organizations listed below may or may not be associated with a national labor organization or a national federation of labor unions. The various possibilities are:

1. An organization of production workers
2. A heterogeneous organization of professional and non-professional employees
3. An organization of engineers
4. An association of engineers and employees in closely related professions such as chemists, physicists, and so forth
5. An organization of all professional employees

In the opinion of the Committee, the first of these possibilities is definitely unsuited to the needs of the engineers. Acceptance of the second would depend upon the history and status of industrial relations in the company, the wishes of the employees, the attitude and integrity of management, and the economic position of the company in the industry. The remaining three possibilities are all suitable forms of labor organizations for engineers. The inclusion of all employees engaged in professional work in a single bargaining agency would make for a larger membership, which in turn would give the agency more prestige whether it becomes associated with one of the national federations of labor organizations or operates as an independent organization. Such an association, when organized on a national basis, would have a substantial treasury which would enable it to engage organizers, retain a research staff, and maintain competent officers and counsel. On the other hand, the more restricted the bargaining agency the greater the community of interest among the members and the easier the task of administration. Internal conflicts of interest would be less likely to arise and objectives and programs could be developed more easily, but external conflicts, such as jurisdictional disputes, would be more likely to occur. Moreover, restricted organizations add to the difficulties of maintaining mutually satisfactory industrial relations, and many separate bargaining agencies not only are time consuming but also complicate the collective-bargaining process.

The committee believes that the choice of the form of organization should be left to the engineers and their associates engaged in professional work. It recognizes that the appropriate bargaining agency may well differ from establishment to establishment. It wishes to point out, however, that the Institute may quite properly advocate and urge on its employee members that in all cases before the National Labor Relations Board they ask for any one of the last three forms of organizations, namely, an association for engineers alone, an association for engineers and their associates in closely related professions, or an association of all employees engaged in professional work. A statement addressed to its members pointing out the form of organization which it believes to be in the best interests of the engineer is quite in order and would not be detrimental to the Institute or its members. The foregoing, however, would not be a proper argument for the Institute to make directly to the National Labor Relations Board in an individual dispute case, because in such cases the Board is concerned only with the wishes of the employees and the enforcement of the Act.

Where a bargaining agency for professional employees exists or is being formed, the committee believes that every effort should be made to include junior engineers. If young engineers are left out of the professional unit and included in a non-professional unit in which they happen to be working temporarily, their interests will not be fully protected. It should be noted that this arrangement has precedent. For example, a pattern maker who is temporarily assigned to work with production employees usually is excluded from the bargaining unit of production workers and retained in the unit of the pattern workers, most of whom ordinarily work in a separate pattern shop.

If young engineers are included in a bargaining unit of production workers in which they happen to be working temporarily, they may be brought under a closed-shop or a union-shop arrangement which might give rise to misunderstandings and irritation when they desired to move up to their regular professional positions. Moreover, they may want to belong to a professional organization during the time they are temporarily assigned to non-professional work, and, if covered by a closed-shop agreement, they would have to pay

dues in two labor organizations. To avoid such complications it would seem advisable to recommend to these young engineers that, whenever they deem it advisable to choose a collective-bargaining representative, they seek admission to a group representing professional employees.

Appendix I. Glossary

Employer as defined in the National Labor Relations Act "includes any person acting in the interest of an employer, directly or indirectly, but shall not include the United States, or any state or political subdivision thereof, or any person subject to the Railway Labor Act, as amended from time to time, or any labor organization (other than when acting as an employer), or anyone acting in the capacity of officer or agent of such labor organization." (Section 2(2).)

Employee as defined in the Act includes "any employee, and shall not be limited to the employees of a particular employer, unless the act explicitly stated otherwise, and shall include any individual whose work has ceased as a consequence of, or in connection with, any current labor disputes or because of any unfair labor practice, and who has not obtained any other regular and substantially equivalent employment, but shall not include any individual employed as an agricultural laborer, or in domestic service of any family or person at his home, or any individual employed by his parent or spouse." (Section 2(3).)

Representative as defined in the Act may be "any individual or labor organization." (Section 2(4).)

Labor Organization as defined in the Act "means any organization of any kind, or any agency or employee representation committee or plan, in which employees participate and which exists for the purpose, in whole or in part, of dealing with employers concerning grievances, labor disputes, wages, rates of pay, hours of employment, or conditions of work." The Board, in accordance with the purpose of the Act (specifically Section 8(2)) has refused to certify unions initiated, aided, or dominated by employers.

Bargaining Unit comprises those classifications of employees that are (*a*) to be included for the purposes of collective bargaining and (*b*) to be covered by the wage contract. The definition may specify the classification to be included or it may list those to be excluded. It may be a craft, plant, company, or a subdivision thereof. (Section 9(*b*).) It is important to note that the Board makes a distinction between the bargaining unit and the labor organization of employees. The Board is not concerned with the composition of the organization so long as it is free from employer domination. Its membership may be less inclusive, more inclusive or coextensive with the bargaining unit. A labor organization of professional employees, for example, could admit to membership young engineers, professional employees temporarily engaged in non-professional work, and employees whose work is of a semiprofessional nature. It might not, however, be certified by the Board as the bargaining agency for any of these special classifications. In making its decision as to what the bargaining unit shall be, the Board strives to bring together in one single unit those employees who have a community of interest which is likely to further harmonious organization and facilitate the objectives of collective bargaining.

Majority-Rule Principle means that where a union is designated by the majority of the voting employees in a bargaining unit, it automatically becomes the sole bargaining agent for all employees (nonmembers as well as members) in the unit.

Union Status is the basic relationship which prevails between the union and the employer under a wage contract. It is a matter of great importance to both the union and management. The more common types of union–management relationships are:

Closed Shop. An arrangement under which (*a*) all employees in the *bargaining unit* are required to belong to the union as a condition of employment and (*b*) the employer agrees to hire only union members (sometimes also to hire only through the union) so long as the union is able to supply needed employees.

Union Shop. An arrangement under which the employer may hire new employees from any source but said employees must become members of the union, usually after a specified trial period.

Preferential Shop. An arrangement under which union members are given special consideration in certain aspects of employment, most commonly in lay-offs and rehiring and sometimes in hiring and promotion.

Maintenance of Membership. An arrangement which does not require any employee to join the union, but which requires those employees who were members when the contract was signed and who failed to resign during the "escape period" (usually 15 days) as well as those who later joined the union, to continue as members during the life of the agreement.

Sole Bargaining Agent. An arrangement under which the union is recognized as the only bargaining agency for all the employees in the unit. Under this type of union–management relations employees may either join or refrain from joining the bargaining agency.

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2. Executive Administration . . . . Salesmen Redefined. Report of the Wage and Hour Division of the United States Department of Labor, October 20, 1940. U.S. Government Printing Office, Washington, D.C.

New in Education

Georgia School of Technology to Adopt Peacetime Program

RECONVERSION of the curricula at the Georgia School of Technology from a wartime to a peacetime basis has been decided, it is announced by Dr. Blake R. Van Leer, president. However, because of Navy, Army, and war training commitments, the change will be made at the end of the 1945–1946 academic year. The peacetime plan will be on the quarter system instead of the semester system.

Under the new plan, there will be only one commencement each calender year, and regular students will be granted bachelor of science degrees in engineering at the end of their fourth year. Cooperative students, who spend part of their time in school and the other part in industry, will graduate at the end of five years. One advantage of the quarter system will be that students with high scholarship standing will have the opportunity to finish a complete engineering course in three years.

Georgia Tech was one of the first engineering colleges to institute an accelerated wartime program, doing so long before Pearl Harbor. The plan proved so successful that the Navy Department used it throughout the country at other institutions.

Since the wartime program has been inaugurated, besides 12,000 regular students and Army and Navy trainees, more than 8,000 have attended hundreds of classes in special subjects of value to the war effort. Companies benefiting by this training have included shipyards, factories, railroads, utilities, and the federal civil service.

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Prewar Semester Schedule at Polytechnic Institute of Brooklyn

AT THE Polytechnic Institute of Brooklyn, the 1945 fall term marks a return to the prewar semester schedule, following three years of the accelerated wartime program of continuous year-round sessions. However, summer courses will be offered as in prewar years.

To assist returning veterans, Polytechnic has a counseling service to explain what requirements they must meet. Also, a series of guidance circulars has been prepared, one devoted to the full four-year requirements leading to the bachelor's degree in each of the following subjects: Aeronautical Engineering, Chemistry, Chemical Engineering, Civil Engineering, Electrical Engineering, Mechanical Engineering, Metallurgical Engineering, and Physical Science.

Special review courses are planned for former students of the Institute who have served in the armed forces. Provisions will be made so that veterans can begin their studies at any time. Periodic progress interviews will be held to help enrolled veterans maintain the standards of achievement essential to the successful completion of their government-sponsored education. Subcollegiate courses in physics, mathematics, and English have been made available for veterans lacking these special entrance requirements so important in a school of technology.

In the fall of 1943, veterans at the Institute organized the first chapter of Gamma Iota Alpha, the GI association now expanding in colleges in different parts of the country.

Since Brooklyn Polytechnic provides a curriculum embracing the various engineering fields, no basic curricula changes are being made beyond the addition of several courses covering advances in aeronautical, electrical, chemical, and civil engineering. A year ago its aeronautical

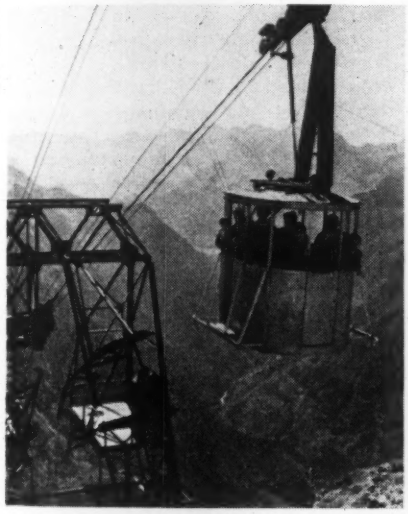
curriculum was enlarged with a course in the theory of jet propulsion. The scientific curricula in chemistry and physics have undergone revisions to embrace latest developments. More attention in atomic physics will be given to nuclear structure and fission.

In the academic year just ended, Polytechnic had a total enrollment, including the 1945 summer session, of 3,432. There were 1,120 in the graduate session, the largest in any engineering college in the country; 1,539 in the undergraduate evening session; and 773 in the undergraduate day session.

* * * *

Field Laboratory Work for G.I.'s at Biarritz

FIELD TRIPS are regular features of the engineering program at Biarritz American University, one of the schools in the American Army's vast postwar educational program. Although problems and theories are discussed in the allotted classroom hours, extended trips to hydroelectric plants in the Pyrenees are made on the average of every two weeks and shorter excursions are offered to the various groups almost daily.



STUDENTS IN CABLE CAR ON WAY TO INSPECT HYDROELECTRIC PLANTS IN FRENCH PYRENÉES

A hydroelectric plant, one of the most modern in all Europe, located less than four miles from the Spanish border and capable of supplying power to any part of France, is a favorite point of interest for G.I. engineering students. Here a study of the elaborate French interconnecting power systems disclosed that European engineers were further advanced on the "tie-in" system than Americans. The largest contributing factor to this development was the shortage of coal in various parts of France and the accessibility of many plants to enemy attack. Students are also able to study sanitary and civil engineering methods, surveying problems, and dam construction.

Shorter trips are usually confined to the Bayonne area, the regional industrial center. Principal points of interest for the G.I. student include a steam power plant, gas manufacturing plant, steel mill, and aeroplane factory.

SOLDIER-STUDENTS OF BIARRITZ AMERICAN UNIVERSITY RIDE ON HIGHEST RAILROAD IN EUROPE

While soldier-students visit these installations to compare European and American methods, it is expected that a select group will actually take over the operation of some of these plants for short periods as a test of their newly gained knowledge. Language differences are overcome by assigning one or more interpreters to each group.

Chief of the Engineering Section of the Biarritz American University is Virgil M. Faires, on leave to the War Department from the Agricultural and Mechanical College of Texas. As head of the Management Engineering Section and Professor of Mechanical Engineering at this southwestern college, Faires has long been an ardent advocate of field laboratory work.

* * * *

Full Night Curricula at Rensselaer

BEGINNING November 1, Rensselaer Polytechnic Institute will make available at night the same educational training heretofore available only in daytime sessions. It will initiate a program of coordinated evening courses leading to baccalaureate and graduate degrees as well as individual courses—all in the fields of engineering, science, management, English, literature, history, and economics. This will be the first time in the 120-year history of R.P.I. that such educational opportunities have been offered there, and the first time that a complete engineering education, obtainable at night, has been available in the state outside the New York City metropolitan area.

One aspect of these evening courses is the opportunity they offer to veterans entitled to educational benefits under the G.I. Bill but who, because of dependents or other reasons, find the financial allowances under the bill insufficient to permit them to attend college without working at the same time.

Application for admission and printed detailed information may be obtained by addressing the Extension Division, Rensselaer Polytechnic Institute, Troy, N.Y., of which division Prof. Stanley B. Wiltse has been appointed chairman.

N. G. Neare's Column

Conducted by

R. ROBINSON ROWE, M. AM. SOC. C.E.

"I THINK," protested Joe Kerr, "that Professor Neare is a plagiarist. He takes an old problem, diverts our attention by inventing a Welsh town that is nothing but CIVIL ENGINEERING in reverse, pretends realism by giving his chief character the good old Welsh name of Tom Liwyendys, and intrigues engineers by loading a transit in the back seat of a jeep, but the problem is still just 10 minutes of algebra."

"Mostly you are right, Joe," admitted the Professor. "New problems are rare, but many old ones are worth revival. What was your answer, by the way?"

"With the back seat carrying a dead load, Tom could carry only one of his party at a time. He started his chainmen walking and drove Gimpy, the lame transitman, 32.8 mi, dropped him to walk the rest of the way and went back to pick up a chainman. Giving each chainman a lift in turn, the party reached Gnireenignelivic in $7^{13}/_{142}$ hr. The order of riding is immaterial. But why didn't you make the distance $47^1/_3$ mi instead of $47^1/_2$; then the answer would be 424 min exactly!"

"I can answer that one," chuckled Ken Bridgewater. "The distance was set up for an answer of 410 min exactly, but Joe jumped to the conclusion that the backseat couldn't be unloaded. Easiest thing in a jeep—just hit the curb at 15 mph as you make a U-turn and pray that Gimpy catches the transit in one hand and the level in the other. So Tom drove Gimpy all the way, unloaded, returned to his rear chainman, U-turned again, picked up his head chainman on the fly and reached the set-up in the 410 min. The joker lay in the futility of the head chainman's extra speed."

"I could use that extra speed and put Gimpy to work," offered Cal Klater, "if you'd let Tom unload his instruments along the road, but a good surveyor like Tom Liwyendys, even tho he is *backward*, wouldn't leave a transit unguarded."

"Then I'll have to show you the camouflage on the old problem," said the Professor, with abominable eagerness. "Tom sent Gimpy and the head chainman walking, drove the rear chainman $7^1/_8$ mi, dropped him in a U-turn, and returned for Gimpy. Then, after taking Gimpy and paraphernalia to the set-up, he returned $21^3/_8$ mi to find his chainmen together. He completed the ferrying operation in 399 minutes exactly as this Time-Space chart will show (Fig. 1).

"Cal's idea of unloading the dead load

by the roadside suggests a sequel that, without any camouflage, requires some ingenuity. Suppose, for example, that the instruments had been shipped ahead to make room for a flagman and his wife, neither of whom could drive or would walk, and, having been married yesterday, couldn't be separated but had no objection to sitting together on the roadside. (Isn't

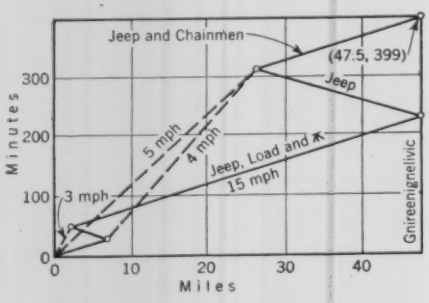


FIG. 1. ODYSSEY OF TOM LIWYENDYS

the help problem aggravating nowadays?) Then how long would it take to move the party?"

(*Many sent in Joe's and Ken's answers. The old problem was sent by a modest contributor with a suggestion for a revival with camouflage. Not being able to use his name, we camouflaged him as Tom, the Chief of Party.*)

New Services Planned by Highway Research Board

TO MEET more adequately the need for correlation and coordination of the work of the many research agencies, the Highway Research Board has announced a plan to expand its facilities by employment of field engineers and by provision for greater support of committee work and publications.

The stated objectives of the Highway Research Correlation Service are to collect all available information concerning past, current, and proposed research work on the subject of highways and highway transportation, by the federal government, state highway departments, colleges and universities, and other research agencies; to study and correlate the information by means of individual and group conferences and committee activities; to prepare reports and make recommendations based thereon; and to disseminate such information, reports, and recommendations among the highway research agencies, so that they will be fully and promptly informed of research activities. It is hoped, also, that a coordinated program of highway research may be planned and carried out as a result of this service without unnecessary duplication of effort, and that greater economy and efficiency in the expenditure of public funds for research activities may be obtained.

The Correlation Service will be in the immediate charge of Fred Burggraf, associate director, under the general supervision of Roy W. Crum, M. Am. Soc. C.E., director.

Whatcom County, Wash., Looks to the Future

A NOTABLE example of the work of Chambers of Commerce in the United States is afforded in a 56-page illustrated pamphlet, "Profit for Your Industry," recently compiled by the General Industrial Survey Committee of the Bellingham (Wash.) Chamber of Commerce.

Intending to give "a factual presentation of Whatcom County, Washington," the Committee enlisted the aid of fifteen subcommittees representing the leadership of the area in business, industry, labor, and agriculture. In fact, the preparation of the material was a community enterprise supported by the best technological and business talents in the Pacific Northwest. The information furnished in the prospectus is being kept up to date to provide interested industrial firms with the complete facts.

Ohio Water Resources Board Undertakes Expanded Program

THOSE INTERESTED in problems of water supply will recall the article by David H. Harker, "Ohio Conducts State Ground-Water Survey" (CIVIL ENGINEERING for July 1945, p. 313), discussing the work of the Ohio Water Supply Board. One of the Board's findings was the need for statewide water-use control measures.

Of interest in this connection is the announcement recently made that the Ohio Water Supply Board, on October 5, changed its name to the Ohio Water Resources Board, and at the same time expanded its authority and activity.

Regulatory activities assigned to the new board are the following:

1. Requiring the filing of well logs.
2. Issuing of regulations regarding the drilling and abandonment of wells to prevent contamination of underground waters.
3. Requiring the filing of plans for dams to be built in the state except those for municipal supplies.

These regulatory functions are to be carried out in addition to an expanded program of investigation, under which the following procedures are to be initiated:

1. A program of installation and operation of water stage recorders on about 100 drilled wells in Ohio, and the securing of weekly tape measurements on about 100 additional drilled wells.
2. A program of stream gaging on drainage areas of less than 20 sq miles to supplement the present stream-gaging program.
3. Analyses of, and publication of, flood frequencies in Ohio; preparation of mass curves and tables for the principal streams of Ohio.
4. Compilation of all records of stream flow in a convenient compendium.
5. A program to collect data on the chemical quality and temperature of the principal streams of Ohio.
6. Test drilling and geophysical surveys of potential ground-water reservoirs.
7. Preparation of comprehensive reports on the water resources of Butler, Hamilton, Stark, and Montgomery counties, which are areas of heavy ground-water use.

This program of work is under the direction of C. V. Youngquist, Assoc. M. Am. Soc. C.E., who previously was with the U.S. Geological Survey in Ohio for 18 years, as district engineer since 1938.

Apprentice Training in Texas Highway Department

FACED WITH a personnel problem during the first few postwar years, the Texas State Highway Department has put into operation an apprentice program for training World War II veterans as draftsmen and mechanics. It is in these fields particularly that there is an insufficient number of trained men available to satisfy the needs of the department. Thus through necessity this training program in cooperation with the Federal Committee on Apprenticeship has been set up.

Now that a beginning is being made on the large volume of highway construction which was deferred during the war, the need for inspectors, instrumentmen, and draftsmen has already become evident. The classifications fall within the training program for apprentices which has been set up by the federal committee. It is only through this affiliation that the Texas department can make available to veterans the benefits to which they are entitled under the "G.I. Bill." The training program has been approved by the federal committee, and applications have already been made to enroll for the instruction.

Veterans are thus offered an opportunity to become skilled workmen and to be paid as they train. The period of apprenticeship is four years, during which time 8,000 hours of study and work are to be done. Upon completion of the course, candidates will be fully prepared for entrance into employment as skilled craftsmen. Since the number to be enrolled is not to exceed the number of skilled workmen that will be needed for permanent employment in the Highway Department, it is probable that the majority of the men trained will continue to work in the department after completion of the training period.

During apprenticeship, the men will be paid on a scale increasing each six months from $100 a month at the start to $135 a month during the last months. In addition the Federal Government, through the Veterans Administration, will pay the difference between this scale and the department's craftsman scale—this not to exceed $50 per month for single men and $75 per month for those with dependents. The present rate for skilled draftsmen and mechanics is $180 per month.

To assure desired results, the program has been placed under the general direction of the State Highway Engineer, D. C. Greer, M. Am. Soc. C.E., and for administration, under the direct responsibility of the district engineers and division heads throughout the state.

New bulkhead of Z-type interlocking steel sheetpiling, driven 2½ ft. behind old timber sheeting, retains fill in this New York shipyard. Contractor, George W. Rogers Construction Corp., New York.

At 15-ft. intervals, 3½ in. steel tie-rods, 19 and 21 ft. long, threaded at ends for sleeve couplings, were driven horizontally through 100 ft. of cinder fill.

(Right) Nearly completed bulkhead with protruding end of tie-rod, ready to install pair of wide steel-beam wales at elevation of tie-rods.

A HANDFUL OF 'INCOR' DID THE TRICK

'INCOR' CONCRETE CAPS HOLD TIE-RODS DRIVEN HORIZONTALLY THROUGH 100' OF SHIPWAY FILL

SCORE another win for construction know-how, with an assist for 'Incor' 24-Hour Cement. Old bulkhead, retaining cinder fill, in one of the Port of New York's principal shipyards, had to be replaced while ship construction proceeded on adjacent shipway.

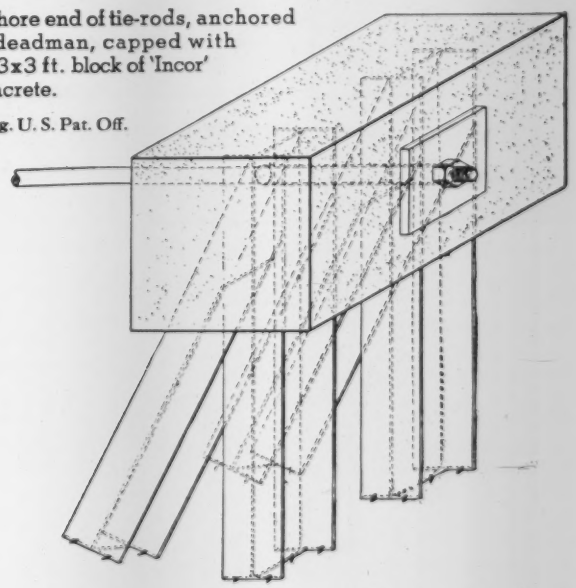
George W. Rogers Construction Co., New York, drove sheetpiling inside old timber sheeting . . . tied the new facing to deadmen located 100 ft. back from bulkhead, by driving heavy steel tie-rods horizontally through fill, at a level 2 ft. above mean low water, between tides in 5-ft. tidal range.

Inshore ends of tie-rods were anchored to deadmen capped with 'Incor' concrete. A handful of 'Incor' did the trick, attaining service strength between tides . . . providing strong, dense, durable concrete to resist difficult exposure conditions.

Timely reminder: Dependable 'Incor' early strength speeds winter work, cuts heat-protection costs 50-60%, halves form costs. Use 'Incor'* for quality, speed and economy.

Inshore end of tie-rods, anchored to deadman, capped with 5x3x3 ft. block of 'Incor' concrete.

*Reg. U. S. Pat. Off.



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LONE STAR CEMENT, WITH ITS SUBSIDIARIES, IS ONE OF THE WORLD'S LARGEST CEMENT PRODUCERS: 15 MODERN MILLS, 25-MILLION BARRELS ANNUAL CAPACITY

Dominion Bridge Company Issues Two Volumes

CELEBRATING 63 years of achievement, the Dominion Bridge Company recently issued two handsomely illustrated volumes—"Builders in Steel" and "Of Tasks Accomplished." The first of these is a 48-page pamphlet intended to give some idea of the comprehensive range of engineering projects undertaken by the company. In the early years of the company's existence steel bridges were among the foremost needs of the Dominion, and the company played a leading role in supplying them.

Later, in World War II, the company turned its attention to such new activities as the fabrication of ship steel, which became one of the most important of its many wartime undertakings. All these new activities and contributions to Canada's war effort are recorded in the 125-page volume, entitled "Of Tasks Accomplished."

Vocational Material on the Civil Engineer and His Job

FOR some time the National Roster of Scientific and Specialized Personnel of the U.S. Employment Service has been preparing vocational material, largely for the convenience of staff members of the Service. In response to increased demand for this material, it is now being made available for public distribution.

The material consists of an occupational brief, a handbook, and a folder on civil engineering. The handbook may be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C., at a cost of 10 cents each. A price has not been set for the occupational briefs, but the charge will be nominal. The folders (5 by 7 in., on cardboard) are available at the National Roster of Scientific and Specialized Personnel, 1006 U Street, N.W., Washington 25, D.C., and may be obtained free, in limited numbers, on request.

NEWS OF ENGINEERS

Personal Items About Society Members

ROBERT D. MITCHELL has returned to the employ of Malcolm Pirnie, New York City consultant, after two years as a major in the Sanitary Corps of the U.S. Army.

HENRY WELLES DURHAM announces that he is returning to his home at Sandwich, Mass., having terminated a three-year connection as civil engineer in the Engineer Research Office, New York City, a branch of the Military Intelligence Division, Office of the Chief of Engineers. His work consisted of the preparation of reports from library research on matters of engineering interest in the various theaters of war, and with peace these activities have terminated.

HAROLD B. GOTAAS, colonel, Sanitary Corps, U.S. Army, has been elected president of the Institute of Inter-American Affairs, an agency of the Office of Inter-American Affairs. In his new post Colonel Gotaas will direct Institute participation in more than a thousand cooperative health, sanitation, food, and nutrition projects in eighteen American republics.

GRANT M. HINKAMP, until lately with the Stone and Webster Engineering Corporation, has accepted a position with the Allis-Chalmers Manufacturing Company, Milwaukee, Wis. He is in the public works division of the industrial sales department.

WILLIAM B. SMITH is retiring as principal engineer for the U.S. Engineer Office at New Orleans, La., after 38 years in government service.

LOUIS F. BIRKEL, JR., has become connected with the Division of Health and Sanitation of the Institute of Inter-American Affairs in the capacity of assistant sanitary engineer. His headquarters will be San José, Costa Rica, where he will aid in the Institute's program of developing public water supplies.

FRANCIS B. WILBY, major general, U.S. Army, has been detached from his duties as superintendent of the U.S. Military Academy at West Point, N.Y., and assigned to succeed BRIG. GEN. GORDON R. YOUNG as commanding general of the Engineer School at Fort Belvoir, Va. General Young will have new duties on the General Staff.

CLARKE K. HARVEY is now planning technician for the Allegheny Conference on Community Development, with headquarters in Pittsburgh, Pa. He was previously office engineer for the Allegheny County Department of Works.

CHARLES J. BARTHOLET, formerly supervisor for the Division of Water Resources of the Washington State Department of Conservation and Development, has been made office engineer.

C. A. WILLSON was recently appointed chief of the non-metallic building materials section of the Building Materials Division of the War Production Board. He was formerly chief of the clay and concrete products section, which has been merged with the non-metallic building materials section.

HENSON K. STEPHENSON has been appointed associate professor of structural engineering in the Agricultural and Mechanical College of Texas. In addition to his new teaching duties, he will retain his present title of research engineer in the Texas Engineering Experiment Station and continue the research work he has been doing since the summer of 1943.

HANS R. JACOBSEN was recently promoted from the position of division engineer for the Reconstruction Finance Corporation, Office of Defense Plants, to that of principal engineer. His headquarters are in Detroit, Mich.

HOWARD T. EVANS, who has just been released from active duty as a commander in the Civil Engineer Corps of the U.S. Naval Reserve, has accepted a position in the structural division of the Stone and Webster Engineering Corporation, in Boston, Mass.

CLYDE L. HUFF has returned to Tex from California and is now manager Willacy County Water Control and Im provement District No. 1.

CARL T. BAER, who was recently re leased from the Corps of Engineers, U.S Army, in which he held the rank of lieu tenant colonel, has resumed his forme position as designing engineer for the Cit of Dallas, Tex.

FRANKLIN W. FISH, JR., lieutenan colonel, Corps of Engineers, U.S. Army, ha been awarded the Legion of Merit for hi work during the past year as chief of th Operations Branch, G-3 Section, Comzon MTOUSA, and later as executive of th Operations Branch, G-4 Section, Allie Force Headquarters.

F. B. MASON, until lately senior resident engineer for the Texas State Highway De partment, at Corpus Christi, Tex., ha been appointed city engineer of Corpus Christi.

GUY H. ELBIN, for the past eight and a half years bridge engineer for the Frank lin County (Ohio) Engineering Depart ment, has been appointed chief bridge engineer for the Ohio State Department of Highways.

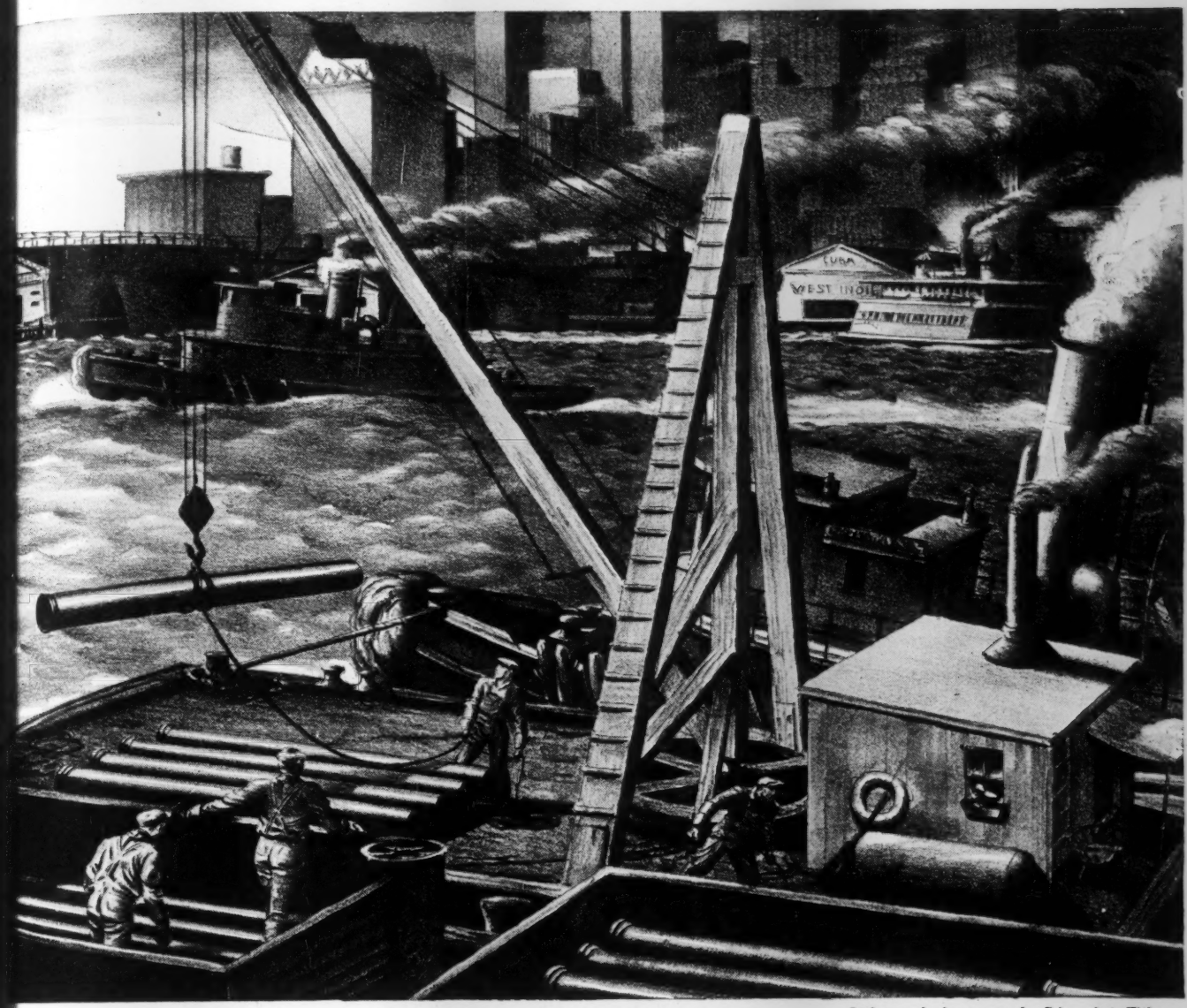
HERBERT D. FRITZ, for the past three years assistant director for the American Public Works Association, in Chicago Ill., has accepted the position of city man ager of Grand Junction, Colo.

JOHN W. WHEELER, who was recently released from active duty in the Corps of Engineers, U.S. Army, in which he held the rank of colonel, has resumed his position as executive assistant to the Chicago Burlington and Quincy Railroad. Colonel Wheeler was with the 9th Army in Europe and early in the summer was awarded the Bronze Star Medal for his engineering achievements that enabled combat troops to force a crossing of the Ruhr River.

JOHN F. BYXBEE has resigned as con sulting engineer for the City of Palo Alto Calif., after many years of service in the public works department. From 1906 to 1941 he was city engineer, and since the latter date he has been consulting engineer on a part-time basis.

FRANKLIN T. MATTHIAS, colonel, Corps of Engineers, U.S. Army, has been revealed to be the commanding officer at the atomic bomb plant near Hartford, Wash. He directed the construction of all buildings, highways, and railroads there, and at present is manager of "Richland," a de velopment similar to Oak Ridge.

JAMES E. GODDARD, lieutenant colonel Corps of Engineers, U.S. Army, was awarded the Bronze Star Medal at a mili tary ceremony in Paris on August 8. The award was given for his work with the mapping and intelligence forces in all parts of the European Theater of Operations. Another member of the Society similarly honored is LT. COL. GEORGE TOMLINSON who was awarded the medal for "meritorious service in connection with operations in the Pacific." He organized the engineering logistic support of combat troops when supplies were limited, and later de veloped an effective program for salvage



Lithographed on stone by Edward A. Wilson

By water, rail and truck, shipments of U. S. Cast Iron Pipe are once again on their way to cities and towns for peacetime projects. Our production curve is steadily on the rise and will be at peak as soon as full complements of trained personnel are again available at our several plants. The locations of these plants, and of pipe stocks carried at various points throughout the country, are advantageous for quick shipment.

U.S. cast iron PIPE

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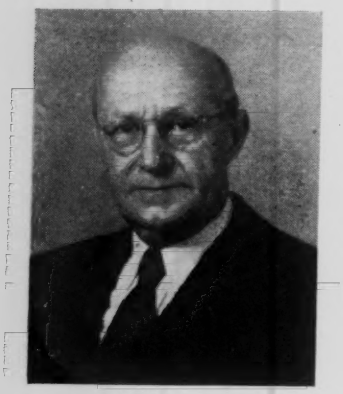
GERARD H. MATTHES retired from government service on September 30 at his own request. He reached the retirement age during the war, but remained as director of the U.S. Waterways Experiment Station at Vicksburg, Miss., to direct the tests for the flood control and navigation projects essential to the successful prosecution of the war. Mr. Matthes went to Vicksburg in 1932 as principal engineer in the office of the president of the Mississippi River Commission, remaining there until 1942 when he was made head of the U.S. Waterways Experiment Station. The many honors that have come to him include election to honorary membership in the Society in 1943. Mr. Matthes expects to make his home in New York City. He will be succeeded as director of the Station by LT. COL. C. P. LINDNER, formerly chief of the Engineering Division of the Mississippi River Commission.



GERARD H. MATTHES

S. O. HARPER is acting as consulting engineer for the Kaiser Engineers. He recently left for Afghanistan where he has been invited to make plans for, and report on, an irrigation project in the valley of the Helmund River.

JAMES C. HOWLAND, who has been in the Pacific Theater of War, was recently promoted from the rank of captain in the Corps of Engineers, U.S. Army, to that of major.

JED N. ROBINSON is now district engineer for the Texas State Highway Department at Austin, the position representing a promotion from that of assistant district engineer, with headquarters at Tyler, Tex.

CLARENCE J. DERRICK, captain, Air Corps, U.S. Army, has been appointed a member of the Los Angeles Board of Public Works.

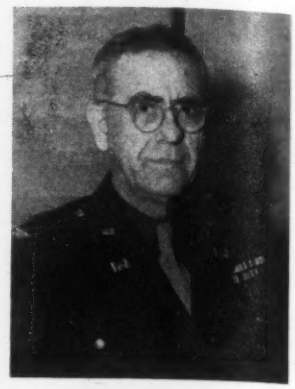
HOMER A. HUNTER is now assistant city manager of Dallas, Tex. He will, also, continue as supervisor of water-works operation. K. F. HOEFLE, formerly distributing engineer for the city's water department, has been appointed acting superintendent of the department.

HAROLD E. SENF, previously associate engineer for the U.S. Engineer Office at Niagara Falls, N.Y., was recently appointed engineer for Warren County, Ohio.

CHRISTIAN L. SIEBERT has severed his connection as executive engineer in the Pennsylvania State Department of Health, with headquarters in Harrisburg, in order to establish a private consulting practice at Camp Hill, Pa.

DAVID W. GRIFFITHS, colonel, Corps of Engineers, U.S. Army, has been assigned to the post of district engineer at Galveston, Tex.

MALCOLM ELLIOTT, colonel, Corps of Engineers, U.S. Army, will be retired from the Army as of December 31, 1945. On September 20 he severed his connection as division engineer for the Upper Mississippi Valley Division at St. Louis, Mo., in which capacity he had served since 1938. Colonel Elliott has spent practically his entire career in the Corps of Engineers and has been district engineer at Wheeling, W.Va., New Orleans, La., and Juneau, Alaska. He was recently awarded the Legion of Merit for the huge construction program he supervised in his capacity as division engineer at St. Louis.



MALCOLM ELLIOTT

RALPH G. WADSWORTH, until lately division chief in the Technical Report Division of the Ernest J. Kump Company, San Francisco, Calif., was recently appointed city engineer of San Francisco.

JOSEPH L. QUINN, JR., has resigned as state sanitary engineer for the Indiana State Board of Health and as technical secretary of the Indiana Stream Pollution Control Board, in order to become connected with Hulman and Company, of Terre Haute, Ind., manufacturers of baking powder. He will be assistant to Anton Hulman, Jr., president of the company.

CHARLES L. COBURN announces that he and Everett N. Montague, a California engineer, have opened consulting offices in San José and Los Gatos, Calif., under the firm name of Coburn and Montague. Mr. Coburn recently severed his connection as chief engineer in the Navy Design Division of the Naval Ordnance Plant at Shumaker, Ark.

CLARK H. ELDRIDGE has just returned to Tacoma, Wash., after forty-four months as a civilian internee in Japan. Mr. Eldridge was serving as superintendent for the Pacific Naval Air Base Contractors on Guam, when he was taken prisoner by the Japanese at the outbreak of the war. His present address is the Young Apartments, North 1st and Stadium Way, Tacoma.

GILES L. EVANS, JR., lieutenant colonel, Corps of Engineers, U.S. Army, has been transferred from Nashville, Tenn., to Technical Division I of the Engineer Board at Fort Belvoir, Va.

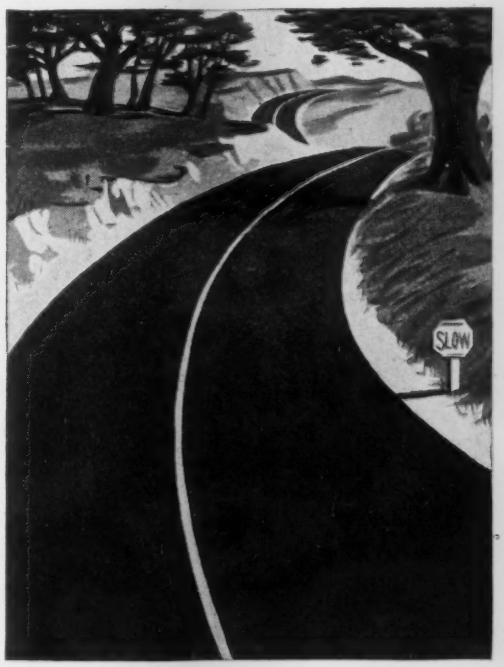
LLOYD D. KNAPP, formerly special assistant engineer in the Milwaukee (Wis.) Bureau of Engineers, has been appointed superintendent of sewers for the city.

GAIL A. HATHAWAY, head engineer in the Office of the Chief of Engineers, has been awarded a Presidential Citation and the Bronze Star Medal for his work as technical representative of the Chief of Engineers in the European Theater of Operations from November 1944 to March 1945. Mr. Hathaway, who has been in the Office of the Chief of Engineers since 1937, is being exceptionally honored, as very few civilians are awarded the Bronze Star Medal. He is a Director of the Society. Another member of the Society honored at the same ceremonies was COL. ENOCH R. NEEDLES, who received the Legion of Merit for his work as chief of the Redistribution and Salvage Branch, Military Supply Division, Office of the Chief of Engineers. Colonel Needles is a former Director of the Society.

COL. E. R. NEEDLES (RIGHT) SEES GAIL HATHAWAY DECORATED WITH BRONZE STAR MEDAL BY GEN. T. M. ROBINS

Asphalt is "tops"...

for making new, easy-riding surfaces on worn-out highways



THE TRAVEL-HUNGRY motorist is going to want highways to match the speed and comfort of his postwar car. You can supply them almost as soon as postwar cars become plentiful if you resurface existing roads with Standard Oil Asphalt.

With proper construction, four-lane trunk lines can be made as smooth-riding as city boulevards. Secondary roads can be widened and resurfaced at a fraction of the cost of rebuilding. All with the minimum of interruption to traffic plus full assurance of having an easily maintained system for many years.

It will pay you in money and in the appreciation of motorists to make Asphalt resurfacing the major part of your 1946 highway plans.

A Standard Oil Representative will be glad to discuss methods used by other states and counties and work out plans for supplying your needs. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois, for the Representative nearest you.

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STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

★ FLEET CONSERVATION SERVICE

DECEASED

URIE NELSON ARTHUR (M. '28) of Pittsburgh, Pa., died on September 13, 1945, at the age of 75. Mr. Arthur spent his early career in railroad work. He then (1907) became connected with the Pittsburgh Department of Public Works, where he remained in various capacities until 1920. From the latter year until 1936 he was chief engineer for the Pittsburgh Department of City Planning.

DEWITT DUKES BARLOW (M. '40) president of the Atlantic Gulf and Pacific Company, of New York, N.Y., died in a hospital in Plainfield, N.J., on September 23, 1945. Had he lived a few days longer he would have been 65. Mr. Barlow had been connected with the Atlantic Gulf and Pacific Company since 1905, serving in the capacity of engineer from 1905 to 1910, secretary from 1910 to 1911, and vice-president from 1911 to 1921. He was president and director from the latter year on. A resident of Plainfield for almost forty years, Mr. Barlow had been mayor, councilman, and president of the Board of Education. During the first World War he served as chairman of the Emergency Dredging Committee and as associate chief of the Dredging Section of the War Industries Board, and in the recent war was active in the Red Cross and other war work.

JOHN ALLEN BEELER (M. '07) consulting engineer of New York, N.Y., died in July 1945. His age was 78. An authority on electric railway transmission, Mr. Beeler was with the Denver City Tramway Company from 1890 to 1915—successively as chief engineer and vice-president and general manager. For part of this period, also, he was vice-president and general superintendent of the Denver and Northwestern Railway Company. Since 1916 he had been connected with the Beeler Organization, New York City firm of public utility engineers and consultants.

CHARLES PERRY CHASE (M. '12) consulting engineer of Clinton, Iowa, died there on August 16, 1945, at the age of 76. Mr. Chase was the first municipal engineering consultant in Iowa, having been in practice in Clinton continuously since 1892. During this period he did general municipal work in over 200 cities and towns through the Middle West. He had also been assistant engineer for the Clinton Bridge and Iron Works, and from 1919 to 1921 was chief engineer for the U.S. Bureau of Housing and Transportation. He was the author of several books on municipal and public works engineering.

JOSEPH ALFRED ELLIOTT (M. '20) president and manager of the Wyoming Development Company at Wheatland, Wyo., died at his home there on August 25, 1945. Mr. Elliott, who was 58, had been field engineer for J. A. Whiting, of Cheyenne, and assistant engineer for the City of Cheyenne. For the past thirty years he was connected with the Wyoming Development Company, serving successively as engineer, superintendent, vice-president, and president and manager. He was the inventor of many new designs in irrigation structures.

FREDERICK SHELTON FOULKROD (Assoc. M. '15) secretary-treasurer of the Hughes-Foulkrod Company, Philadelphia, Pa., died on September 22, 1945. He was 60. Early in his career Mr. Foulkrod was with the McClintic-Marshall Company, for which he was in charge of the design of the approaches to Hell Gate Bridge in New York. Since 1916 he had been in charge of all engineering and financial matters for the Hughes-Foulkrod Company, specialists in the construction of industrial buildings.

FRANK WARREN GARRAN (M. '33) dean of the Thayer School of Engineering at Dartmouth College, died in the college infirmary on September 18, 1945, at the age of 51. Returning in 1919 from overseas service in the Corps of Engineers, Dean Garran served as assistant professor of civil engineering at Norwich University, his alma mater, until 1924. He took his master's degree at M.I.T. in the latter year, and then taught at the University of Arizona and Charleston (S.C.) College. He had been associated with the Thayer School since 1929, and had been dean since 1934. During the recent war Dean Garran directed the engineering, science, management war-training courses, sponsored by the government.

GEORGE ESTYN GOODWIN (M. '09) died in Santa Cruz, Calif., on September 15, 1945, at the age of 70. Long a resident of Hood River, Ore., where he maintained a consulting practice, Mr. Goodwin went to Santa Cruz recently for his health. Earlier in his career he had been resident engineer on river and harbor improvement for Maine and Massachusetts and construction project engineer for the U.S. Reclamation Service (now the Bureau of Reclamation). He had also been chief civil engineer for the National Park Service. More recently he was resident engineer for the Corps of Engineers, U.S. Army, on the construction of Bonneville Dam.

GRAHAM MCFIE HATCH, JR. (Assoc. M. '40) captain, Construction Quartermaster Corps, U.S. Army, died in a prison camp in Japan on February 9, 1945. He was 37 years old, and an alumnus of the Agricultural and Mechanical College of Texas. From 1934 until he entered the Army in 1940 Captain Hatch was sanitary engineer for the City of Dallas, Tex. Going overseas in October 1941, he was captured at Corregidor in May 1942 while serving in the Quartermaster Construction Office in Manila. He was held at Cabanatuan after his capture and moved to Japan later.

JOHN MCILRATH IRVINE (Assoc. M. '36) civil engineer of Philadelphia, Pa., died on September 4, 1945, at the age of 50. For a number of years Mr. Irvine was resident engineer for, and assistant to, the president of, the Philadelphia firm of Albright and Friel. About two years ago he established an engineering practice under the firm name of John M. Irvine Associates. During the first World War he served overseas with the Corps of Engineers.

BOYLE IRWIN (Assoc. M. '17) designe for the Warner Company, of Devaul Pa., died at his home in Pottstown, Pa on September 16, 1945. His age was 5 Much of Mr. Irwin's career centered in an around Philadelphia—he had had a struc tural engineering and architectural prac tice there and, more recently, had a con sulting office in Paoli.

RICHARD ALDEN KEASEY (Jun. '41 first lieutenant, Corps of Engineers, U.S Army, died in a Japanese prison camp on Honshu Island, Fukuoka, on February 4 1945. Lieutenant Keasey, who was 34 had been in the Corps of Engineers, U.S Army, since 1941, and was assistant chief in the Construction Section Headquarters in Manila when captured. From 1931 to 1934 he was with the Oregon State Highway Department, and from 1934 to 1941 in the U.S. Engineer Office. He received the degree of B.S. in C.E. from Oregon State College in the latter year. His home was in Portland, Ore.

BURTON LOWTHER (Assoc. M. '08) consulting engineer of Denver, Colo., died on September 7, 1945, at the age of 71. Mr. Lowther had been engineer of tests and materials for the Bell Telephone Company, of Kansas City, Mo.; vice-president of the Moechel and Lowther Engineering Company, chemists and metallurgists of Kansas City; and chief engineer for the Kansas City Water Department. For the past twenty years he had maintained a consulting practice in Denver.

JAMES CLARENCE OGDEN (M. '11) president of the Robert W. Hunt Company, of New York, N.Y., died in Plainfield, N.J., on September 10, 1945, at the age of 77. Mr. Ogden had been with the Robert W. Hunt Company since 1893—from 1902 to 1931 in the capacity of manager of the New York office, and since the latter year as president. Earlier in his career he was with the Atlantic Refining Company and the Pittsburg Testing Laboratory, both in Philadelphia.

CHARLES SMITH SHELDON (M. '15) former bridge engineer for the Pere Marquette Railway, died in a hospital in Detroit, Mich., on July 25, 1945. Mr. Sheldon, who was 74, spent his entire career in railroad work. From 1903 to 1913 he was assistant engineer for the Cincinnati, Hamilton and Dayton Railway at Cincinnati, and from 1913 to 1942 bridge engineer for the Pere Marquette at Detroit. After his retirement in the latter year he made his home in Batavia, Ill., and during the year before his death had been in St. Petersburg, Fla.

RALPH CARL SMITH (Assoc. M. '41) insurance agent for the Stricker P. Smith Agency at Camas, Wash., died in a hospital in Spokane on September 2, 1945. His age was 51. From 1917 to 1940 Mr. Smith was in the Washington State Highway Department—for part of this period as resident engineer on various projects. He then served as principal inspector of construction for the U.S. Navy on the building of the Kodiak (Alaska) Naval Air Base, and later was employed at the Spokane air depot.